III. FIRE AND FUELS

Introduction

Fire has historically been the dominant disturbance factor in forests across the northern Rocky Mountains and has created the current mosaic patterns observed across the landscape. Most forests have evolved with the continual influence of fire. Forested communities and ecosystems depend on this type of disturbance regime for their continued perpetuation on the landscape (Habeck and Mutch 1973).

Natural Historic Fire Regimes best illustrate fire disturbance patterns. A fire regime describes the frequency, predictability and severity of fire in an ecosystem. Fire regimes can range from non-lethal to stand-replacing levels, typically becoming less frequent as severity increases.

Drought cycles and fuel availability have a considerable influence on fire regimes. Wildland fires often occur during the driest months of the year, typically July, August and early September, and can have considerable effects to an area during drought periods. The quantity and type of fuels also affect fire behavior. Fire fuels are made up of dead woody debris and living vegetation. Fuel quantities can vary considerably, depending on the vegetation composition and recent fire history.

Fire hazard reflects the potential fire behavior and magnitude of fire effects as a function of fuel conditions. Fuels are characterized as crown fuels (live and dead material in the canopy of trees), surface fuels (grass, shrubs, litter and wood in contact with the ground surface) and ground fuels (organic soil horizons, or duff, and buried wood). The crown fuels and surface fuels are of most concern in the fuel reduction treatment areas.

Fires could start and have been started in the past by humans or lightning. The Red Whale Project area is becoming more populated and visited, increasing the likelihood for human caused fires. Large fires are also not uncommon in the area as evidenced by the Moose Fire in 2001, the Robert Fire in 2003 and the Wedge Canyon Fire in 2003.

Information Sources

Fire history information is reported to the National Interagency Fire Management Integrated Database (NIFMID) by the Forest Service. Vegetation and fuels information was derived through a combination of site visits by specialists, common stand exam data, satellite imagery and aerial photography. More detail on vegetation information can be found in the vegetation portion of the project file. Weather information was obtained through NIFMID, which catalogues historical weather and fire occurrence data. The Polebridge Remote Automated Weather Station (RAWS) was used as the source of the weather data for this project area. Weather from RAWS stations is reported to and catalogued by NIFMID.

Slope, aspect and elevation for fire behavior modeling were derived from a digital elevation model. The existing fuels information was compiled using a combination of common stand exams, field visits, VMAP satellite imagery and the Landscape Fire and Resource Management Planning Tools Project (LANDFIRE Project). The VMAP imagery is described in the vegetation portion of the project file. The LANDFIRE Project was initiated by a request from federal land agencies asking the principal investigators to develop maps needed to prioritize areas for hazardous fuel reduction.

The objective of the LANDFIRE Project is to provide the spatial data needed by land and wildland fire managers to accurately identify the amount and locations of lands or communities with hazardous fuel build-up or extreme departure from historical conditions. These data also facilitate the prioritization of ecosystem restoration and hazardous fuel reduction treatments to protect ecosystems, property and people. Moreover, these data may be used during specific wildland fire incidents to maximize firefighter safety, pre-position resources and evaluate fire behavior under a variety of fire weather conditions. These spatial data and predictive models will be hierarchically designed so that they can be used at the national, regional and local levels. LANDFIRE is a joint multi-agency project between the US Department of Agriculture Forest Service (USDA FS), the US Department of Interior Geological Survey (USGS), the Bureau of Land Management, the National Park Service, the Bureau of Indian Affairs, the Fish and Wildlife Service and The Nature Conservancy; with the principal investigators located at the USDA FS Rocky Mountain Research Station Fire Sciences Laboratory (Missoula, Montana) and the USGS National Center for Earth Resources Observation and Science (Sioux Falls, South Dakota). For more information on LANDFIRE visit www.landfire.gov.

Often, a combination of models and site visits was used to determine a specific fuel value. The landfire project was used primarily for the fuel characteristics; however, site visits to verify or adjust values were performed by the district fuel specialist for each treatment area.

Analysis Area Description

The area evaluated for the fire and fuels section is the project area. It was chosen because it follows ridgelines and natural barriers. The total acreage of all ownerships in the analysis area is 86,128 acres, with private land consisting of 7,485 acres. The fire regime patterns in the analysis area are characteristic of those in the northern Rocky Mountain region. Elevation is varied, ranging from 3500 to over 8000 feet. Topography is also varied with most of the lower elevations consisting of gentle slopes and the higher elevations being rugged. Vegetation ranges from spruce in the lower, wetter areas to subalpine fir and whitebark pine at higher elevations. For a more specific break down of species cover types, see the vegetation section of the project record.

Affected Environment/Existing Condition

Historic Natural Fire Regimes

This classification system includes five historical fire regimes (see Table 3-10). Fire Regime I (0- to 35-year frequency, low severity) is found primarily in forests that experience frequent, low-severity, nonlethal surface fires. Fire Regime II (0 to 35-year frequency, stand-replacement severity) is found primarily in grass and shrublands. Because fire consumes the dominant above-ground vegetation in the form of grasses or shrubs, fire severity is considered to be stand replacing regardless of the plants' response to fire (Brown 1994). Fire Regimes III (35 to 100+ year frequency, mixed-severity), IV (35 to 100+ year frequency, stand-replacement severity), and V (200+ year frequency, stand-replacement severity) can occur in any vegetation type (USDA Forest Service General Technical Report RMRS-GTR-87. 2002).

Table 3-10. Historical Natural Fire Regimes

Classification	Description
I	0–35-year frequency[1], low severity[2]
II	0–35-year frequency, stand-replacement severity
III	35–100+ year frequency, mixed severity
IV	35–100+ year frequency, stand-replacement severity
V	200+ year frequency, stand-replacement severity

[1] Fire frequency is the average number of years between fires.
[2] Severity is the effect of the fire on the dominant overstory vegetation.

The majority of the Red Whale Project area is classified as fire regime IV. The moist habitat types are generally classified as fire regime IV. There are some areas that are classified as fire regime III on lower slopes or southern aspects. Further analysis on historic natural fire regimes was not deemed necessary because none of the mechanical treatments are intended to replicate these fire regimes. The proposed prescribed burn areas are all classified as fire regime III. Prescriptions for prescribed burning are intended to produce a mixed severity fire, similar to expected results from a historic natural fire.

Condition Class Descriptions

Condition classes are a function of the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, structural stage, stand age and canopy closure (refer to Table 3-11). One or more of the following activities may have caused this departure: fire exclusion, timber harvesting, grazing, introduction and establishment of exotic plant species, insects and disease (introduced or native), or other past management activities.

Table 3-11. Condition Classes

Condition Class	Attributes	Example Management Options
Condition Class 1	• Fire regimes are within or near an historical range • The risk of losing key ecosystem components is low. • Fire frequencies have departed from historical frequencies by no more than one return interval. • Vegetation attributes (species composition and structure) are intact and functioning within an historical range.	Where appropriate, these areas can be maintained within the historical fire regime by treatments such as fire use.
Condition Class 2	• Fire regimes have been moderately altered from their historical range. • The risk of losing key ecosystem components has increased to moderate. • Fire frequencies have departed (either increased or decreased) from historical frequencies by more than one return interval. This results in moderate changes to one or more of the following: fire size, frequency, intensity, severity or landscape patterns. • Vegetation attributes have been moderately altered from their historical range.	Where appropriate, these areas may need moderate levels of restoration treatments, such as fire use and hand or mechanical treatments, to be restored to the historical fire regime.
Condition Class 3	• Fire regimes have been significantly altered from their historical range. • The risk of losing key ecosystem components is high. • Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, frequency, intensity, severity or landscape patterns. • Vegetation attributes have been significantly altered from their historical range.	Where appropriate, these areas may need high levels of conversion restoration treatments, such as hand or mechanical treatments. These treatments may be necessary before fire is used to restore the historical fire regime.

(USDA Forest Service General Technical Report RMRS-GTR-87. 2002)

The majority of the Red Whale Project area is considered condition class 1, characterized by relatively long fire return intervals. There are a few areas of fire regime III that are in or nearing condition class 2. Overall, the project area is generally described as not being outside the historic natural range of variability for fire return. However, much of the project area that has not experienced timber harvest or large fire in the past 100 years is nearing the end of its natural fire return interval.

Fire History

Fire history start data for the Red Whale Project area is from 1912 – 2006 (see Maps 3-1 and 3-2). Refer also to discussion on Fire History in the Forest Vegetation section of Chapter 3. There are 146 known fire starts indicated in the analysis area. This project utilized fire history information based on historic accounts and records. These are included in the project record. The U.S. Forest Service keeps records of all known fires. They also have historic accounts of past large fires. There was no fire history study, such as fire scar analysis, performed in this area to determine fire history prior to 1900. The limitation of using historic accounts based on Forest Service or other records is that data integrity is often unknown in the past and little data exists for the pre-1900 era. This information was not deemed critical due to the purpose and need for this project. The treatment unit locations and prescriptions are designed near private land to reduce fire behavior from fires in the future, not to mimic past fire events. Large fires in the area include the Wedge Canyon Fire (2003), the Red Bench Fire (1988) and the Moose Fire (2003).

Wildland Urban Interface (WUI)

Flathead County recently completed a community wildland fire protection plan. This plan described what is considered wildland urban interface in Flathead County. This county plan defined the WUI within Flathead County as being the area immediately adjacent to wildland or forest fuels within 1.5 miles of residential structures, developments or private properties suitable for development or for residential use. All of the mechanical fuels treatments in each action alternative for this project are contained within the area defined as wildland urban interface. The majority of the prescribed burn units are not considered in the wildland urban interface.

Existing Forest and Fuels Condition

The existing forest conditions are described in the vegetation section of this EA. The existing fuel conditions are variable across the landscape. Surface fuels are described with a fire behavior fuel model number in order to classify fuels conditions for estimated potential fire behavior (Anderson 1982). The fuels are classified based on several factors including type of fuel and amount of surface fuel present. These fuel models are used to predict fire behavior resulting from various weather inputs. The majority of the timbered areas are classified as fire behavior fuel model 10. There are few areas of fuel model 8 in the project area. These would be mostly locations that have experienced past harvest and some form of surface fuel reduction. Fuel model 5 conditions exist on some shrub dominated slopes, primarily on southerly aspects. Areas of very dense saplings are also modeled as fuel model 5. There are also pockets of heavy downed fuels resulting from mountain pine beetle mortality over the last 20 years. These areas are highly variable and difficult to model. They are shown as fuel model 10; however, they could be displayed as a heavier fuel loading model such as 12. Many of the grass dominated, lower elevation areas (mostly private land) would be considered fuel model 2. More detail on existing conditions within treatment units can be found in the environmental consequences section under the no action alternative discussion. Following is a list of fuel model descriptions found in the project area. There are many other fuel models not included here because they are rare or non-existent in the project area.

Grass Group

Fire Behavior Fuel Model 2. - Fire spread is primarily through the fine herbaceous fuels, either curing or dead. These are surface fires where the herbaceous material, in addition to little and dead-down stemwood from the open shrub or timber overstory, contribute to the fire intensity. Open shrub lands or low brush and pine stands that cover one-third to two-thirds of the area may generally fit this model; such stands may include clumps of fuels that generate higher intensities and that may produce firebrands.

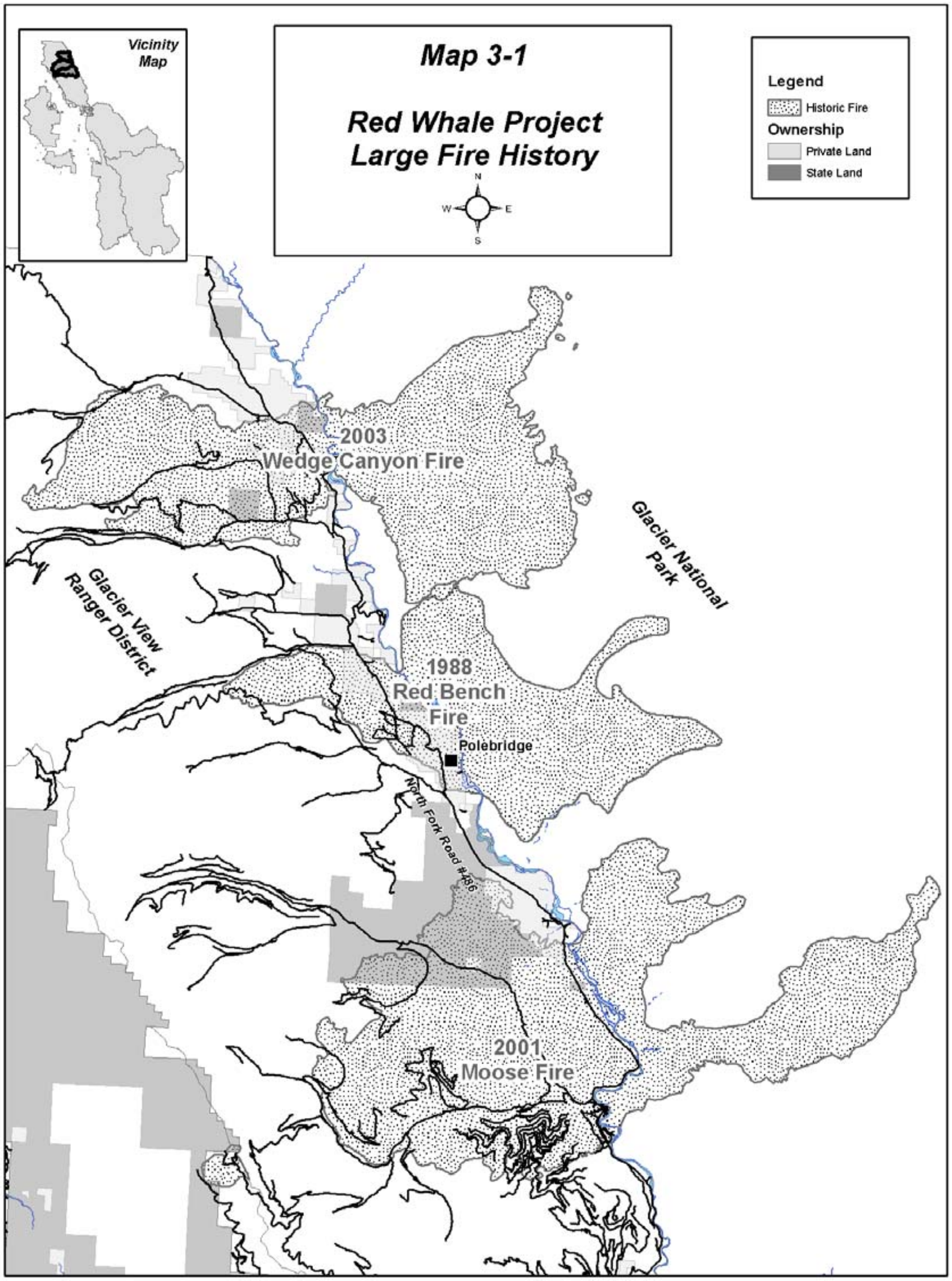
Shrub Group

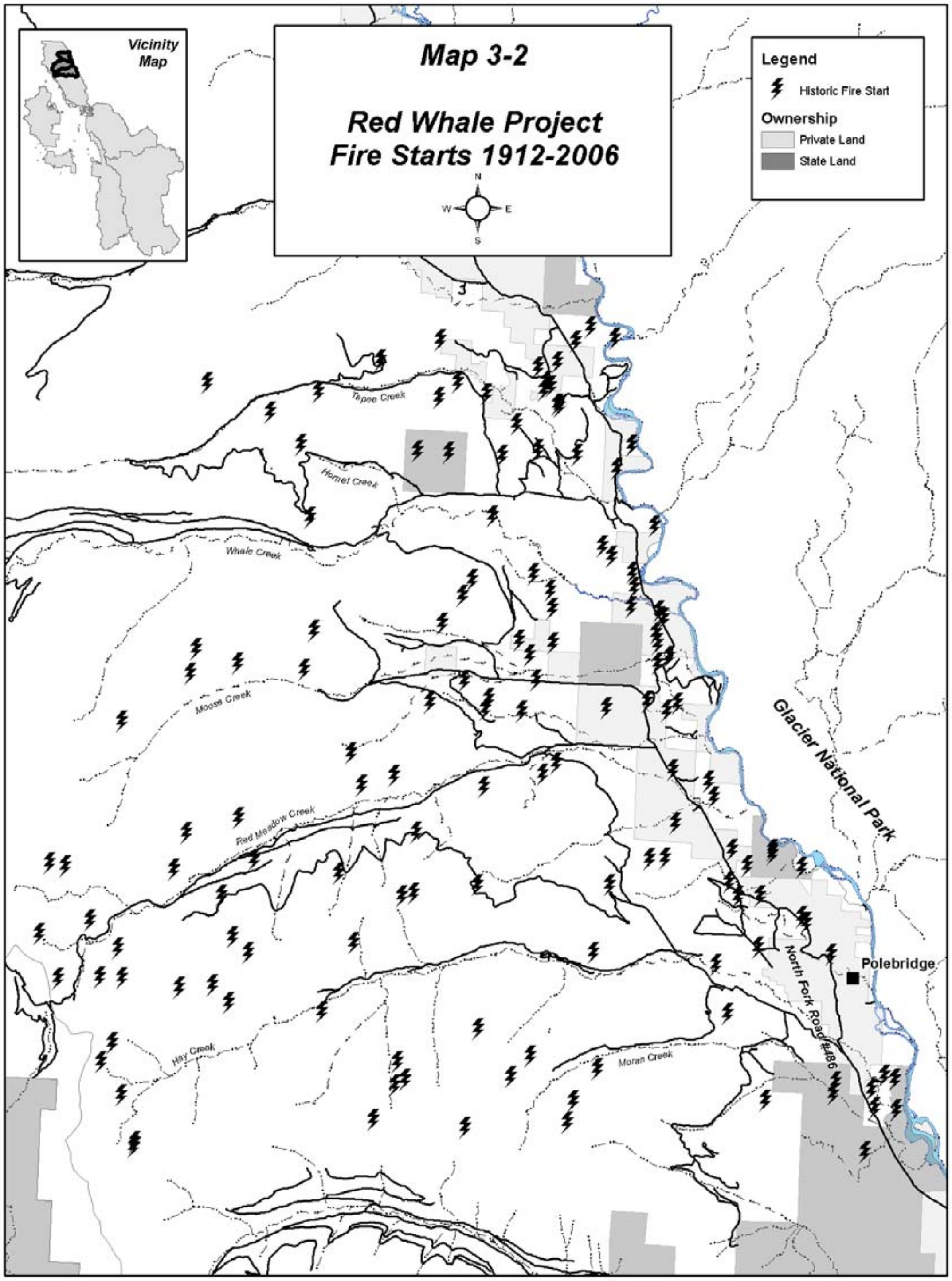
Fire Behavior Fuel Model 5. Fire is generally carried in the surface fuels that are made up of litter cast by the shrubs and the grasses or forbs in the understory. The fires are generally not very intense because surface fuel loads are light, the shrubs are young with little dead material, and the foliage contains little volatile material. Usually shrubs are short and almost totally cover the area.

Timber Litter Group

Fire Behavior Fuel Model 8 (closed timber litter). Slow-burning ground fires with low flame lengths are generally the case, although the fire may encounter an occasional "jackpot" or heavy fuel concentration that can flare up. Only under severe weather conditions involving high temperatures, low humidity and high winds do the fuels pose fire hazards. Closed canopy stands of short-needle conifers or hardwoods that have leafed out support fire in the compact litter layer. This layer is mainly needles, leaves and occasionally twigs because little undergrowth is present in the stand.

Fire Behavior Fuel Model 10 (timber litter and understory). The fires burn in the surface and ground fuels with greater fire intensity than the other timber litter models. Dead and down fuels include greater quantities of three-inch or larger limbwood resulting from over-maturity or natural events that create a large load of dead material on the forest floor. Crowning out, spotting and torching of individual trees is more frequent in this fuel situation, leading to potential fire control difficulties. Any forest type may be considered if heavy downed material is present; examples are insect or disease-ridden stands, wind-thrown stands, over-mature situations with deadfall, naturally thinned stands and aged light thinning. These types may have a well-developed vertical or ladder fuel component.


Vicinity
Map
Map 3-1
Red Whale Project
Large Fire History
N
W
E
S
Legend
Historic Fire
Ownership
Private Land
State Land
2003
Wedge Canyon Fire
Glacier National
Park
Glacier View
Ranger District
1988
Red Bench
Fire
Polebridge
North Fork Road #486
2001
Moose Fire


Vicinity Map
Map 3-2
Red Whale Project
Fire Starts 1912-2006
N
W
E
S
Legend
Historic Fire Start
Ownership
Private Land
State Land
Tepee Creek
Hornet Creek
Whale Creek
Moose Creek
Red Meadow Creek
Hay Creek
Moran Creek
Glacier National Park
North Fork Road #486
Polebridge

Logging Slash Group

Fire Behavior Fuel Model 11. Fires are fairly active in the slash and herbaceous material intermixed with the slash. The spacing of the rather light fuel load, shading from overstory, or the aging of the fine fuels can contribute to limiting the fire potential. Thinning operations in mixed conifer stands are considered.

Fire Behavior Fuel Model 12. Rapidly spreading fires with high intensities capable of generating firebrands can occur. When fire starts, it is generally sustained until a fuel break or change in fuels is encountered. The visual impression is dominated by slash and much of it is less than three inches (7.6 cm) in diameter. The fuels total less than 35 tons per acre (15.6 t/ha) and seem well distributed. This fuel model is represented by heavily thinned conifer stands when slash is not treated.

Analysis Methods - Fire Behavior Modeling

Fire behavior modeling is performed to estimate a number of fire behavior characteristics. There are three main categories of inputs to fire behavior modeling; weather, fuels and topography. Weather is classified and discussed in more detail in the climatology section later in this report. Historic weather information is used as an input to estimate fire behavior. Fuels are classified as surface fuels and crown fuels. Surface fuels are described with a fire behavior fuel model number (Anderson 1982). Crown fuels are described by canopy bulk density (the foliage contained per unit crown volume), canopy base height (the average height from the ground to the lowest living foliage), and canopy fuel load (the volume of canopy fuel load) (Scott and Reinhardt 2001). Crown fuels are important for determining crown fire characteristics such as whether a fire can transition from the ground to the tree crowns. The topography input related to fire behavior is percent slope. Slope can effect how a fire burns. Fires generally burn with more intensity and faster spread rates when burning on steeper slopes.

There are several outputs available with fire behavior modeling. The outputs of most concern for this project include rate of fire spread, flame length, type of fire, torching index and crowning index. Fire behavior characteristics are used to estimate resistance to control. This is defined as the relative difficulty of constructing and holding a control line as affected by resistance to line construction and by fire behavior (National Wildland Coordinating Group Handbook 3, 2004).

The rate of spread indicates how fast a fire will move. The flame length is important to fire suppression techniques. If flames are over 4 feet, suppression with hand crews is generally unsuccessful. If flame lengths are over 8 feet, mechanized equipment is not considered effective.

The type of fire is also very important to estimate how successful suppression efforts will be, or resistance to control. Fire scientists and managers recognize three general types of wildland fire depending on the fuel stratum in which the fire is burning.

Ground Fire

A ground fire is one that burns in ground fuels such as duff, organic soils, roots, rotten buried logs, etc. Ground fires are generally ignited by surface fires. Ground fires have very low spread rates. For these reasons, ground fires are not predicted or further discussed in this analysis because they would be secondary to and in association with a surface fire.

Surface Fire

A surface fire is one that burns in the surface fuel layer, which lies immediately above the ground fuels but below the canopy, or aerial fuels. Surface fuels consist of needles, leaves, grass, dead and down branch wood and logs, shrubs, low brush, and short trees. Surface fire behavior varies widely depending on the nature of the surface fuel complex. Surface fires are generally easier to contain than any type of crown fire.

Crown Fire

A crown fire is one that burns in the elevated canopy fuels. Canopy fuels normally consumed in crown fires consist of the live and dead foliage, lichen, and very fine live and dead branchwood found in the forest canopy. We generally recognize three types of crown fire: passive, active and independent.

<u>Passive.</u> A passive crown fire, also called torching, or candling, is one in which individual or small groups of trees torch out, but a solid flame is not consistently maintained in the canopy. These can encompass a wide range of fire behavior, from the occasional tree torching out, to a nearly active crown fire. The increased radiation to surface fuels from passive crowning increases flame front spread rate, especially at the upper end of the passive crown fire range. Embers lofted during passive crowning can start new fires downwind, making containment more difficult and increasing the overall rate of fire growth. Passive crowning is common in many forest types, especially those with an understory of shade-tolerant conifers.

<u>Active.</u> An active crown fire is a crown fire in which the entire fuel complex becomes involved, but the crowning phase remains dependent on heat released from the surface fuels for continued spread. Active crown fires are characterized by a solid wall of flame extending from the fuelbed surface through the top of the canopy. Greatly increased radiation and short-range spotting of active crown fires lead to spread rates much higher than would occur if the fire remained on the surface. Medium and long-range spotting associated with active crowning leads to even greater rates of fire growth. Containment of active crown fires is very difficult.

<u>Independent.</u> An independent crown fire is one that burns in canopy fuels without aid of a supporting surface fire. Independent crown fires occur rarely and are short-lived, requiring a combination of steep slope, high windspeed, and low foliar moisture content. Many apparently independent crown fires may actually be active crown fires in which the canopy phase is momentarily pushed ahead of the surface phase under the influence of steep slope or strong wind. Few cases of independent crown fire have been documented. Independent crown fires are not addressed because they occur so rarely and because no model of their behavior is available.

Torching index is defined as the 20-ft wind speed at which some kind of crown fire (passive or active) is expected. Crowning index is defined as the 20-ft windspeed at which active crown fire is possible (Scott and Reinhardt 2001). These two indices are often useful when comparing fuels conditions rather than in an absolute sense. For example, if one forest stand has a much higher torching index than another, it is assumed that the higher index indicates that stand is less likely to experience torching under consistent weather conditions than the stand with the lower index.

Fire Behavior Modeling Tools

The computer program NEXUS 2.0 (2005 version) was used to predict fire behavior characteristics for treatment units. NEXUS predicts both surface fire and crown fire behavior. NEXUS is not a spatial fire behavior model. It requires weather, fuels and topography inputs provided by the user. The output from NEXUS is not spatial in nature; rather it is for a specific set of input values.

A landscape fire assessment was completed for the Red Whale Project area. The assessment used two spatial fire behavior computer models, FARSITE (version 4.1.03) and FLAMMAP (version 2.0 from 2004), to predict fire behavior characteristics across the entire project area. This is helpful for viewing and assessing fire characteristics spatially. The NEXUS fire behavior model only predicts for a specific area. The spatial models account for wind direction, fuels, slope, aspect, canopy cover and tree height across an entire landscape. Maps included in the project file display fire type, rate of spread and flame length before and after treatment. The model used 90% and 97% ERC weather.

Both modeling approaches were included due to advantages and disadvantages of both. While NEXUS allows for very specific inputs and detailed fire behavior characteristic outputs, it does not account for spatial changes in fuels or topography. It also requires specific inputs often involving field verification of the fuel conditions. Because of the detailed input required, its use is limited to areas were fuel data exists. For example, often site specific fuel data for private lands is not available for input to NEXUS.

The landscape scale fire assessment approach using FARSITE and FLAMMAP is coarser in nature. These models use large scale data layers as inputs. Pixels of 30 square meters are used for estimating fuel inputs. The fuels input information used in this analysis was from a combination of VMAP and LANDFIRE data (discussed in the Information Sources section). These data layers are coarse compared to NEXUS inputs; however, they are consistent across all ownerships. This allows for an estimate of fire behavior across multiple ownerships using the same level of detail in the input data.

Climatology

Weather information was obtained from http://famweb.nwcg.gov/weatherfirecd/ for the Polebridge Remote Automated Weather Station for the time period from 1986-2006. The computer program Fire Family Plus version 3.0.1.0 (USDA Forest Service 2002) was used to summarize the weather data. Table 3-12 shows the percentile weather used for fire behavior calculations (see project file, section J for a printout of the Percentile Weather Report).

Table 3-12. Percentile Weather by Energy Release Component (ERC)

	90% ERC	**97% ERC**
1 Hour Fuel Moisture	4.2	3.2
10 Hour Fuel Moisture	5.8	4.8
100 Hour Fuel Moisture	12.1	11.5
1000 Hour Fuel Moisture	14.6	12.8
Herbaceous Fuel Moisture	82.7	69.3
Woody Fuel Moisture	105.4	91.3
20 Foot Wind Speed	8.1	12.4

Energy Release Component (ERC), a number related to the available energy per unit area within the flaming front at the head of a fire, was used to categorize weather. ERC is often used for planning and estimating the relative fire danger on any given day. For example, weather conditions associated with the 97th percentile ERC would only be expected to occur on approximately 3 percent of the fire season days. The 90th percentile ERC and 97th percentile ERC weather conditions were calculated to be used as inputs when modeling fire behavior. By displaying both weather conditions, a range of expected fire behavior can be modeled.

Fuel moisture is the amount of moisture in a piece of fuel relative to its oven dried weight. Fuel moistures are displayed in six categories based on type of fuel (live or dead) and size class. The size classes for dead fuels are as follows; 1 hour fuels are 0 to ¼ inch in diameter, 10 hour fuels are ¼ to 1 inch in diameter, 100 hour fuels are 1-3 inches in diameter, and 1000 hour fuels are 3 + inches in diameter. Dead fuels are classified in this manner because different sizes of fuels take different amounts of time to gain or lose moisture, thus the number of hours associated with each (Anderson 1982). Live fuels are classified as either herbaceous or woody, depending on the type of plant.

Twenty foot wind speed is the speed of the wind measure 20 feet above the vegetation. It is important to note that 20 foot winds are often three times the strength of the wind we feel on the ground in a forested area. For example, in a moderately dense conifer stand it would take a 20 mph 20 foot wind to produce a 6 mph eye level wind (National Wildland Coordinating Group Handbook 3, 2004). Eye level winds are often referred to as mid-flame winds because these are the winds that most directly effect surface fires. Mid-flame wind speeds are calculated from 20 foot winds by using a wind adjustment factor (National Wildland Coordinating Group Handbook 3, 2004). When a forested stand density is reduced through removal of trees, the potential mid-flame wind speeds increase. This was considered and adjusted when estimating fire behavior in post fuel reduction treatment areas.

Environmental Consequences

Introduction

This section describes the direct, indirect and cumulative effects of the proposed treatments on the fire and fuels resource. To focus the fire/fuels analysis and describe relevant effects, the following effects indicators are used:

- acres treated in the wildland urban interface (WUI)
- predicted rate of fire spread (chains/hour)
- predicted flame length (feet)
- type of predicted fire
- torching index
- crowning index

Proposed treatments areas for each alternative were categorized into 6 stand groups. The first 5 groups represent fuels and stand conditions in areas proposed for mechanical treatments. The sixth group consists of areas proposed for prescribed burning. These groups are explained further in the vegetation section of Chapter 3 as well as in the section of Chapter 2 that explains details of the proposed mechanical fuels reduction treatments. The fuels characteristics specific to each of these groups can be found in the NEXUS section in the project file, section K. Although no treatments are proposed in Alternative 1 (No Action), fire behavior is still displayed by stand group in order to provide a comparison in similar stand groups for the no action and action alternatives.

Direct and Indirect Effects of Alternative 1 (No Action)

Fuels Treatments

Under Alternative 1, no fuel treatment would occur. In the absence of disturbance, fuel conditions would generally persist or fuel loadings would increase throughout the project area over the next 15 years. The following table (Table 3-13) displays predicted fire behavior in six distinct stand groups. Fire behavior was modeled using 90th and 97th percentile weather inputs. The NEXUS fire behavior model was used for predicting fire behavior specific to each stand group.

Table 3-13. Effects Indicators for Alternative 1

Stand Group	WUI Acres Treated	Rate of Spread (chains/hour)		Flame Length (feet)		Fire Type		Torching Index (MPH)		Crowning Index (MPH)	
		90th	97th	90th	97th	90th	97th	90th	97th	90th	97th
1	0	1.6	20.8	2.5	15.2	Surface	Passive	9	5.7	18.8	16.7
2	0	1.6	35.3	2.5	37.1	Surface	Passive	9	5.7	14.1	12.4
3	0	1.6	35.6	2.5	39.8	Surface	Active	9	5.7	12.9	11.4
4	0	1.6	2.7	2.5	3.2	Surface	Active	16.1	12.3	24.3	21.7
5	0	6.3	16.7	3.6	6.8	Passive	Passive	0	0	32.7	29.2
Prescribed Fire	0	21.4	46.9	18	39.6	Passive	Active	0	0	13.8	11.8
Total	**0**										

Access Management

Alternative 1 proposes no access management changes.

<u>Direct and Indirect Effects Common to Alternatives 2, 3, and 4</u>

Fuels Treatment Principles and Considerations

Fuel treatments reduce the crown and surface fuels by thinning trees and burning, removing, or chipping fuel on the ground. Table 3-14 describes the effects of some fuel treatment principles.

Table 3-14. Fuel Treatment Principles[1]

Principle	Effect	Advantage
Reduce Surface Fuels	Reduces potential flame length	Improves control, reduces torching
Increase Canopy Base Height	Requires longer flame length to start torching	Reduces torching
Decrease Crown Density	Makes tree-to-tree crown fire less likely	Reduces potential for crown fire
Retains and Grows Larger Trees Favoring Fire Tolerant Species	Increases proportion of trees with thicker bark, taller crowns	Increases tree survival

[1] Adapted from Agee, J. K. 2002. Fire behavior and fire-resilient forests. In: Fitzgerald, S. A., ed. Fire in Oregon's forests: risks, effects, and treatment options. Portland, OR: Oregon Forest Resources Institute: 119.126.

The proposed fuel reduction techniques focus on reducing the potential for crown fires and high intensity surface fires in treatment units, and thus reducing the resistance to control. Thinning of trees would reduce the crown density. By removing understory trees it would also increase the canopy base height, making it more difficult for a crown fire to be initiated. The thinning would primarily focus on removing the smaller trees and species that are less resistant to fire, leaving larger, fire resistant species where possible. The proposed surface fuel treatment would reduce the amount of surface fuels to lower potential flame lengths. This would decrease the resistance to control and reduce the likelihood of crown fire initiation. The preferred method for surface fuel treatment in order would be first removal, then chipping, or lastly excavator piling and burning. By reducing the fuel loading to approximately 10 to 12 tons per acre, consisting of primarily the largest material available, surface fire behavior would be consistent with a fire behavior fuel model 8 (Anderson 1982). By comparison a fuel model 10 has on average 12 tons per acre just in materials less than 3 inches in diameter (Anderson 1982).

The prescribed fire areas are a mix of open shrub dominated areas and timber. Prescribed burning is intended to reduce dead and down fuels as well as cause mortality in understory trees and patches of overstory trees. It will also kill the above ground portion of shrubs and forbs. This will only have a short term effect on fire behavior in the shrub dominated areas because resprouting is expected to occur. The resulting vegetation in the timber dominated areas should be in a more open condition with fewer ladder fuels and surface fuels.

All action alternatives (2, 3 and 4) proposed varying amounts of fuels treatments. These occur as mechanical fuels reduction treatments and prescribed burns. Although much of the prescribed burnings primary objective is to benefit wildlife, a secondary effect of burning would be fuels reduction. Only one of the prescribed burns is located in the wildland urban interface, Unit 9 in Alternative 4.

The major difference in the alternatives is the number of acres treated in each stand group. There are other differences discussed specifically under each alternative. The prescribed treatment for each stand group is the same for each alternative. For example, if an area considered as Group 1 is to be treated in each alternative then the treatment is the same also. This results in identical post treatment predicted fire behavior characteristics. While the expected fire behavior following treatments is identical for each alternative, the acres of treatment vary. The only effects indicator that changes for each action alternative is acres treated in the wildland urban interface. The following tables display post treatment predicted fire behavior characteristics (Table 3-15) for each stand group using NEXUS and acres treated by stand group in the wildland urban interface (Table 3-16). The fire behavior characteristics can be compared to the no action alternative for a before treatment and after treatment comparison.

Table 3-15. Post Treatment Fire Behavior Effects Indicators for Alternative 2, 3 and 4

Stand Group	**Rate of Spread (chains/hour)**		**Flame Length (feet)**		**Fire Type**		**Torching Index (MPH)**		**Crowning Index (MPH)**	
	90th	**97th**	**90th**	**97th**	**90th**	**97th**	**90th**	**97th**	**90th**	**97th**
1	1.1	1.9	.9	1.1	Surface	Surface	344.5	307.8	40.2	35.9
2	1.1	1.9	.9	1.1	Surface	Surface	344.5	307.8	27.8	24.8
3	1.1	1.9	.9	1.1	Surface	Surface	344.5	307.8	24.3	21.7
4	1.1	1.9	.9	1.1	Surface	Surface	205.3	183.4	40.2	35.9
5	1.1	1.9	.9	1.1	Surface	Surface	84.2	75.1	65.7	58.8
Prescribed Fire	2.2	3.6	1.2	1.5	Surface	Surface	192.3	171.7	18.1	15.7

Table 3-16. Acres Treated in the Wildland Urban Interface for Alternative 2, 3 and 4

Stand Group	**Alternative 2**	**Alternative 3**	**Alternative 4**
1	274	224	323
2	734	259	1305
3	128	44	128
4	574	354	897
5	368	46	930
Prescribed Fire	0	0	68
Total	**2078**	**927**	**3651**

Summary of Changes in Fire Behavior for Pre-treatment (Alternative 1) and Post-Treatment (Alternatives 2, 3, and 4) by Stand Group

This section provides a narrative description of the quantified changes in fire behavior characteristics by stand group. Table 3-13 displays predicted fire behavior for the no action alternative and Table 3-15 shows post treatment fire behavior characteristics for Alternatives 2, 3, and 4. Detailed tables showing each fuel characteristic before and after treatments can be found in the project file, section J, under the NEXUS portion.

Group 1

These areas were considered surface fuel model 10 and were predicted to experience surface fires under 90th percentile weather conditions and passive crown fires under 97th percentile conditions before treatment. The models indicate it would only take a 5.7 mph 20 foot wind speed to cause torching and a 16.7 mph 20 foot wind speed to cause crowning under 97th percentile conditions.

Post-treatment areas would be fuel model 8 and were predicted to experience relatively slow moving, short flame length surface fires. In contrast to the 5.7 mph 20 foot wind speed required for torching before treatment under 97th percentile weather, post treatment conditions are predicted to require a 307 mph wind. It would also now require a 35.9 mph 20 foot wind speed to sustain crown fire. These changes are due primarily to large reductions in the amount and density of tree crowns.

Group 2

These areas are very similar to Group 1 related to fire behavior characteristics. The main difference is the 20 foot wind speed needed to sustain crown fires was 12.4 mph before treatment and 24.8 mph after treatment.

Group 3

These areas are similar to Group 1 concerning winds needed for torching before and after treatment. The major difference is that an active crown fire was predicted pre-treatment under 97th percentile weather conditions. Post treatment it would take a 21.7 mph 20 foot wind speed to cause an active crown fire under similar weather conditions.

Group 4

Much like Group 3, these areas have an active crown fire predicted for pre-treatment under 97th percentile weather conditions. Post treatment these areas would require a 183.4 mph 20 foot wind speed to induce torching and a 35.9 mph 20 foot wind speed to support active crown fire under 97th percentile weather conditions.

Group 5

These areas had torching predicted before treatment under both 90th and 97th percentile weather conditions. Post treatment these same areas had surface fires predicted under both weather conditions. The model also predicted it would take 20 foot winds over 75 mph to cause torching under the 97th percentile weather conditions.

Prescribed Fire Areas

The main difference in fire behavior inputs in these areas compared to the mechanical treatment areas is slope. The prescribed fire areas are generally quite steep, causing higher fire intensity than on the relatively flat areas of mechanical treatments under similar weather conditions. These areas exhibited the highest intensity fire behavior both before and after treatment due to the steep slopes.

Seasonal Treatment Considerations

Timing restrictions are often placed on treatment of certain units due to a number of factors. These can be related to soils concerns, wildlife issues, recreation impacts, or access needs. In order to address potential timing considerations or conflicts, an analysis was performed to determine which units would be impacted by potential timing restrictions with regard to fuels treatment effectiveness. The primary concern related to timing restrictions are units that would need to have fuels reduction work performed during a time period when snow presence is likely. Snow cover makes it difficult for operators of grinding or chipping equipment to see rocks and other obstacles, resulting in damage to equipment.

The presence of snow may limit the effectiveness of fuels reduction in primarily two situations. First would be areas that have surface fuel loadings that exceed the desired amount (approximately 10 to 12 tons/acre). In these areas, snow cover may prevent effective fuels treatment because operators may be unable to see smaller downed fuels. Larger down logs may be visible; however these are often the least concern for fuels reduction. Second are areas that have smaller seedling/sapling trees targeted for removal. When cutting or grinding a small tree to induce mortality, it is important to cut to a height that the lowest live limbs are removed. Snow cover makes this task difficult, which may result in fewer trees removed and higher stumps than was desired. Based on these two criteria, each unit in each alternative was reviewed to determine which units could be treated during any season (including times with snow cover). These are the units that do not have one or both of the previously discussed criteria. A more detailed list of these timing considerations can be found in the project record.

Table 3-17. Units that Could be Treated During Any Season (Including Periods of Snow Cover)

Alternative	Units
2	B, C, D[1], E, G, M, BB, H[2]
3	B, C, D[1], E, G, M, BB, H[2]
4	B, C, D[1], E, G, M, BB, 4A, 4B, 4D, H[2]

[1] Northern portion of D only
[2] Southern portion of H only

Access Management

All action alternatives propose changes to access management within the project area. In general these include a short section of new road to a portion of Montana DNRC land and gating or berming existing Forest Service roads (see Chapter 2 for a detailed listing of proposed access management changes).

The additional section of new road is adjacent to the North Fork Road. This will have little or no effect on access for fire management because the North Fork Road is already so close to the area.

Berming, gating, or removing of culverts on roads could limit fire management vehicle access to portions of the project area. This is often most critical during initial attack (the first response to a fire). During extended attack fires, or fires that take several days of fire management, it is not uncommon to utilize equipment to re-open roads for vehicle travel. Closing roads to public travel may also minimize the potential for person-caused fires that may occur because of reduced travel along roadways. Early detection would continue to play a key role in preventing small fires from growing into large fires. Fire detection efforts would not change and would continue to rely mostly on lookouts and aerial patrols.

Much of the project area is already remote and unroaded. Where this is an issue, delivery of firefighting personnel may be accomplished aerially with smokejumpers or helitack crews. Suppression costs during initial attack associated with aerial delivered personnel might be somewhat higher but may be more efficient and effective in limited access areas. In most instances response time to a fire is critical although rapid response may be secondary to environmental elements associated with fuel loadings, topographical features, and fire weather. These components play a very important role in fire behavior and fire growth and would determine what resources would be needed and how many.

Closing roads generally would not affect public safety. The precise location of a fire start cannot be predicted. Fire behavior of a start also cannot always be accurately predicted for an extended period, because weather and fuels vary over time. If extreme fire conditions are predicted or exist, restrictions and/or closures may be put into effect to limit public access to the forest. Generally, emergency exit from the project area would not be impeded by proposed road closures. The Red Meadow Road does allow for access over the Whitefish Divide and is proposed for a gate closure in Alternative 3. The forest that the Red Meadow Road passes through has not experienced fire in several decades, making the road undesirable as an escape route. Safer options for escaping large fires would be to travel north or south on the North Fork Road through the large fire areas from 2001 and 2003.

Direct and Indirect Effects of Alternative 2

Alternative 2 proposes 3,442 acres of fuels reduction treatments. Mechanical treatments would involve 2,078 acres (all in the wildland urban interface) and prescribed fire would account for the remaining 1,364 acres (none in the wildland urban interface). This alternative focuses mechanical treatments on areas closest to private lands. It also strategically locates treatment areas to take advantage of adjacent existing roads and previous treatment areas. Because of the amount of area treated, unit prescriptions and locations, this alternative effectively addresses wildland fuel levels within the wildland-urban interface (WUI), meeting the purpose and need for the project of lowering the risk of severe and intense wildfire, improving our ability to initial attack and control fires, and protecting human life by providing a safer environment for firefighters.

Direct and Indirect Effects of Alternative 3

Alternative 3 proposes 2,119 acres of fuels reduction, of which 927 acres are mechanical (all in the wildland urban interface) and 1,192 are prescribed burning (none in the wildland urban interface). It includes only 94 acres of seedling/sapling treatment in the Red Bench Fire area. Alternative 3 reduces the size of several units and eliminates many that occur in Alternative 2. It also leaves buffers of untreated areas along many of the roads to mitigate wildlife concerns. These buffers may reduce the effectiveness of the treatment units. Often a road is used as a firebreak or control line, especially when it is adjacent to a fuels treatment unit. Leaving an area untreated between a road and a treatment unit may result in an area of higher intensity fire behavior during a burn out operation or wildfire. The expected fire behavior in an untreated buffer would be similar to the indicators displayed in Alternative 1 for each group.

This alternative does respond to some degree to the purpose and need for the project, but not as well as Alternatives 2 and 4. This is because of the substantially reduced acres treated and the location and configuration of the units.

Direct and Indirect Effects of Alternative 4

Alternative 4 includes 5,014 acres of fuels reduction with 3,583 acres of mechanical (all in the wildland urban interface) and 1,431 acres of prescribed fire (68 in the wildland urban interface). This alternative is similar to alternative 2 except it has additional units to increase the amount of mechanical fuels reduction in the project area. It also includes one additional prescribed burn unit than is in Alternative 2, which is in the wildland urban interface. This alternative proposes the most mechanical and prescribed fire fuels reduction of the three action alternatives. It is the most effective at meeting the purpose and need due to the amount of acres treated and their strategic location on the landscape.

Conclusions

The goals of the fuels reduction portion of this project described in the purpose and need (Chapter 1) include; lower the risk of severe and intense wildfire should a fire occur in the future (i.e., reduce the probability of a crown fire), improve our ability to initial attack and control fires, help protect human life by providing a safer environment for firefighters and the public should a fire occur, protect identified human and natural resource values in the event of a future wildfire, and increase the diversity of tree composition to more fire tolerant species.

All of the alternatives support the purpose and need to varying degrees. Fire behavior modeling indicates that in all alternatives, fuels reduction treatments reduce the probability of crown fires. The firefighting environment would be improved due to reductions in resistance to control. This is indicated by reductions in rate of spread, flame length, and crown fire potential after treatment. Due to these reductions in fire intensity, our ability to initial attack and control fires would be improved. This should allow firefighters to better protect human and natural resource values due to reduced fire behavior intensity and resistance to control. Throughout all treatment areas, fire tolerant species would be favored and in many areas these species would be planted.

The differences in effectiveness are mostly related to the number of acres treated in each alternative and the location of the treatment areas. Alternative 4 is the most effective in meeting the goals of the purpose and need due to the highest number of acres treated in the wildland urban interface. Alternative 3 would be least effective due to the location of the units and the least amount of acres treated in the wildland urban interface. This alternative leaves untreated buffers along many roads making them less effective than treating the entire area. Alternative 2 and 4 do not propose buffers, making them generally more effective.

Cumulative Effects

The cumulative effects area for the fire/fuels analysis is the same as the analysis area for direct/indirect effects. This area includes federal, state, and private lands. There are events outside of this area that may be discussed. This is due to the nature of fire moving across the landscape. A fire starting well outside the project area could burn into it in a relatively short amount of time.

The Wedge Canyon Fire in 2003 burned a large area to the north of the project area. This fire should reduce the likelihood for large fires to move into the project area from the north. Fire salvage logging in the Wedge Fire area has reduced the amount of biomass in several areas; however the smaller diameter material is still present in most areas. This has had little effect to change the amount of smaller diameter woody material that would have been present without salvage logging. Over time, the material would have accumulated on the ground through natural processes.

There has been extensive past timber harvesting on the Forest Service lands (see the vegetation section of the project file). Many of these areas have since regenerated to have thick understories of conifer trees. There are many treatments proposed in each alternative in past harvest areas. Regardless of ownership and the type of disturbance, the main concern related to fire/fuels is the current expected fire behavior. This is displayed using FLAMMAP as discussed previously. FLAMMAP output is included in the project record. These projections are related to the current fuel conditions, regardless of past fire, timber harvest, or other disturbance events.

Forest products use such as firewood cutting, Christmas tree cutting, post and pole gathering, bough and cone collecting, and huckleberry picking have had and should continue to have little effect on fire and fuels in the area. With any removal of woody material such as dead trees or small understory trees, there may be a reduction in the potential fire behavior for that exact area. This reduction would be very minor and have little or no effect on the overall fire behavior for the area. With increased use, however, there may be increased potential for human caused fires. This could come from equipment such as vehicles and chainsaws, or recreational campfires. Once again, this increased risk is minimal and the Forest Service typically mitigates the potential for human caused fires during high fire danger periods by placing restrictions on use.

Recreation in the area also falls under the previous description of increased use and potential for human caused fires. In some cases more people may allow for detection of small fires by private parties. The effect of this is also minimal.

Road construction and maintenance may increase the ability for firefighters to use roads as fuel breaks. This is particularly true of road brushing activities. This effectively widens the fuel break characteristics of a road. There may be some new road built on private land, but within the overall area there are very few or no new foreseeable roads.

Many private landowners have performed fuels reduction work on their own properties with the help of government grants. The proposed treatments in the project would have a cumulative effect with some of the treatments on private lands. In some cases, the treatments may be directly adjacent to each other. This work should increase the likelihood that structures would be prevented from burning in the event of a wildfire.

Regulatory Framework and Consistency

The proposed actions are consistent with the Flathead National Forest - Forest Plan and the Flathead National Forest Fire Management Plan.

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