Fallen Bear Fire and Fuels Report

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Regulatory Framework

Forest Plan Direction

IPNF forest-wide management direction states "Provide efficient fire protection and fire use to help accomplish land management objectives" (USDA Forest Service 1987).

Forest Plan fire management standards provide for fire protection and use standards to be specified by management area. "Cost effective fire protection programs will be developed to implement management direction based on on-site characteristics that affect fire occurrence, fire effects, fire management costs and fire caused changes in values." Management area standards define requirements for fire protection.

Prescribed fire is utilized in accordance with management area standards to accomplish specific resource objectives, such as to manage wildlife habitat, meet silvicultural objectives as prescribed in the silvicultural prescription, or other area objectives. Fire management is a support function integrated with and responsive to the management direction established in the Forest Plan. The use of fire is within predetermined criteria to meet specific management objectives.

Appendix F of the Forest Plan states:

> Fire is a natural force in the ecosystem of the IPNF. The effects of fires will be detrimental or desirable depending on when and where fires occur and nature of the fires relative to management objectives. Prolonged fire exclusion leads to changes in forest composition and distribution patterns, which can also have detrimental or desirable consequences. Ecological principals relative to fire must be integrated into fire use and protection requirements along with requirements for resource protection and efficiency. Fire use and protection standards included in each management area will:
>
> 1. Use prescribed fire where it is the most effective way to achieve ecosystem responses required for management objectives.
> 2. Reduce the total cost of land management by integrating fire protection and fire use in management direction.

Fire Management Plan

The Fire Management Action Plan (FMP) is developed in accordance with and is guided by Forest Plan standards. The standards state that fire will be used to achieve management goals according to direction in management areas. "Activity fuels will be treated to reduce their potential rate of spread and fire intensity so the planned initial attack organization can meet initial attack objectives" (USDA Forest Service 1987 IPNF Forest Plan p. II-38).

The IPNF FMP identifies two fire management units in the Fallen Bear Analysis Area. Those portions of the project area that are within one-half mile of the St. Joe River Road (FH50) are designated as Wildland Urban Interface (WUI). The St. Joe River Road is a primary escape corridor for Avery residents and Forest Visitors in the event of wildfire. This feature of the St. Joe River Road was identified as part of the wildland urban interface in the Shoshone County Fire Mitigation Plan. The identified WUI extends ½ mile in all directions from the road. Fire management direction within the defined WUI includes:

> "All wildland fires in the FMU, regardless of cause, are unwanted events and will be managed as suppression events. The goal of suppression is full control using sufficient forces and direct management actions to contain the fire to as small an area and with as little damage or loss to resource values as possible." (IPNF FMP 2008)

The second FMU is the General Forest Zone. The majority of the Project Area lies within this FMU. Fire management direction for this FMU is:

> "All wildland fires in this FMU, regardless of cause, are unwanted events and an appropriate suppression response will be implemented. In this FMU the values to be protected from fire may allow managers to implement a conditional suppression response that does not include an expectation of full containment and control through direct management actions, and one that

tolerates a larger area to be involved by the fire than is the case in the WUI and Mixed Ownership FMU. There are scattered tracts of private lands present within the FMU."

"An objective of fire suppression in this FMU is to keep suppression costs commensurate with values at risk. Forest Plan Management Area direction is to use suppression strategies appropriate to achieve the best benefit-cost ratio based on timber values and/or appropriate wildlife or other identified resource values as identified by MA direction" (IPNF FMP, 2008).

Forest Service Manual

Forest Service Manual 5130.2 states: "The objective of fire suppression is to safely suppress wildfires at a minimum cost consistent with land and resource management objectives and fire management direction as stated in fire management action plans." Minimum cost considerations usually lead to decisions of aggressive initial attack to keep fires small unless other less aggressive suppression responses to contain or confine wildfire are deemed more cost effective.

Analysis Area

The analysis area for the direct, indirect, and cumulative fire and fuels effects analysis is the same as the vegetation analysis area because the fuels used in the fire and fuels analysis are directly associated with the vegetation within a given stand. The current information and data for vegetation is displayed in this analysis. The analysis area for fire and fuels analysis is the area that includes the stands that fall partly or completely within the Fallen Bear Project Area. It includes approximately 10,527 acres which consist entirely of National Forest System lands. This project area is included in the larger area that was used for the Quartz Gold Ecosystem Analysis at the Watershed Scale (EAWS) and Road Assessment Process (RAPS).

Analysis Methods

The information used in this analysis is a combination of available data, research material, literature, field reviews, and assessments. Diagnosis and analysis of stands within the Fallen Bear Project Area were accomplished using stand summary data, basic stand data, stand component data, and stand activity data (Forest Vegetation Report).

Habitat types were used for the project planning and site-specific considerations in this environmental analysis. *Forest Habitat Types of Northern Idaho: A Second Approximation* (Cooper and others 1991) outlines the classification and characteristics of the habitat types. *Fire Ecology of the Forest Habitat Types of Northern Idaho* (Kapler, Smith, and Fischer 1997) and *Fire History on the Idaho Panhandle National Forest* (Zack and Morgan 1994) were also used to assess the current and historic fire regime of the project area.

Habitat types were grouped to facilitate watershed-level analysis and planning because of similar environments and vegetation characteristics such as productivity, disturbance regimes, stand dynamics, susceptibility to insect and disease, forest cover types, structural stages, and successional pathways. *A Biophysical Classification, Habitat Groups and Descriptions* (USDA 1996) was used for this analysis.

Prescribed fire and fuels treatments are based on existing and desired stand conditions, the proposed harvest and regeneration activities, and the fire history of the analysis area. Proposed treatments were developed to facilitate the achievement of the desired condition over time. Considerations included predicted post-harvest stand composition, stand size class, stand structure, estimates of existing fuel loads, calculated predictions of potential fuel loads, and qualitative estimation of potential fire effects based on modeled trends in fuel loading and literature review.

The general guidelines to predicting slash fuel loadings available through the photographic series *Appraising Slash Fire Hazard in Idaho* (Morgan and Shiplett 1989) may be utilized after timber harvest is complete to inform final determination of the necessary type and amount of fuel treatment to be implemented on a unit by unit basis.

The effectiveness of fuel treatments, relative to creation or maintenance of fire resilient forests (Agee and Skinner 2005) was considered in the assignment of fuel reduction activities to individual stands. Recent experimental results from the Fire and Fire Surrogate study, which compare the effects of a variety of fuel reduction treatments dry western mixed conifer stands (Stevens and Moghaddas 2005; Agee and Lolley 2006; Youngblood and others 2007) were also considered.

The Forest Vegetation Simulator (FVS) was used to analyze trends in fuel loading, fire intensity, and fire severity over time. FVS is widely utilized by forest managers throughout the United States and Canada to predict the effects of vegetation management action on future forest conditions. The Fire and Fuels Extension to FVS (FFE-FVS) integrates FVS with elements from existing models of fire behavior and fire severity. Model outputs display fuels, stand structure, snags, and potential fire behavior over time and provide a basis for comparing proposed fuel treatments (Reinhardt and Crookston 2003). FFE-FVS was used in this analysis to describe the existing conditions of the forest stands in the Fallen Bear analysis area and to compare the effects of proposed treatments within each alternative.

Information about existing vegetation was obtained from the Field Sampled Vegetation database (FSVeg) that was developed from stand exam information, historical records and aerial photo interpretation. This information was used in FFE-FVS, which was developed to assess the risk, behavior, and impact of fire in forest ecosystems. The FFE-FVS was created in order to link the changes in forest vegetation due to growth, mortality, and management, with changes in fire behavior, using existing models and information wherever possible (Beukema and others 2000).

FFE-FVS was used to assess the risk of fire to a stand with criteria such as potential flame length, fire type (e.g. surface fire or crown fire), the probability of torching, and the critical wind speed required to initiate and/or sustain a crown fire. This model is not intended to predict the probability of fire or the spread of fire between stands (Reinhardt and Crookston 2003). It is used solely to assess the potential fire behavior and fire effects possible considering current and potential future stand conditions.

Three primary indicators of fire hazard were used to evaluate the changes in fire behavior in forested stands. First, the potential flame length (which is related to fuel loading and fuel arrangement) was used to determine the surface fire behavior potential, as well as the trend over time. Suppression tactics are directly related to flame lengths. For example, personnel using hand tools may construct fire lines directly on a fire perimeter if flame lengths are less than 4 feet (National Interagency Fire Center 2008).

The second indicator of fire hazard used in this analysis was the probability of torching. A torching situation is generally defined as one where tree crowns of significantly large trees are ignited by the flames of a surface fire or flames from burning crowns of small trees that reach the larger trees. This index estimates the probability of finding a torching situation in a forest stand. The probability of torching is the proportion of small places where trees are present and torching is possible. To calculate this index, fire conditions such as surface fuels, fuel moisture and wind speed are needed. The probability of torching is sensitive to the flame length and key process in stand development – the development of understory vegetation, the decline of overstory trees, and crown recession. Management actions that modify these key processes modify the predicted value of the probability of torching.

The third indicator of fire hazard used in this analysis was the crowning index. The crowning index is the wind speed, 20 feet above the canopy, at which active crowning is sustained (but not necessarily initiated) (Scott and Reinhardt 2001; Reinhardt and Crookston 2003). The crowning index reflects the density of canopy fuels. Active crown fire, sometimes called running or continuous crown fire, occurs when the entire surface and canopy fuel complex are simultaneously involved in flaming combustion; but the crowning phase remains dependent on heat from the burning surface fuels for continued spread through the crowns. Active crown fires are characterized by a solid wall of flame extending from the top of surface fuel bed through the top of the canopy (Scott and Reinhardt 2001). Active crown fires result in complete mortality of the overstory because they consume the crowns of the involved trees. Sites with lower crowning index values are more prone to crown fire than site with higher crowning index values. Although critical wind speeds were used as indices, the site conditions (surface and canopy fuel characteristics, slope steepness), not the weather, are being rated (Scott and Reinhardt 2001).

All of the indices used (flame length, probability of torching, and crowning index) need to be considered in conjunction with one another. For example, increasing the crowning index over time (indicating an associated decrease in crown fire hazard) does not necessarily indicate a positive trend for potential fire suppression activities as surface fire flame lengths may increase, decrease, or not change at all depending on effects to wind reduction and fuel loading amongst other factors.

Affected Environment

Fire has been an important natural disturbance process within the Fallen Bear Project Area. Fire disturbance regularly occurred; and certain plants, animals, and many of the physical environments were affected, modified and sustained by fire. Fire history studies indicate that periodic low- to moderate-intensity, mixed-severity fires occurred

on regular intervals of 30- to 80-years. Lethal stand-replacing fires occurred as frequently as every150 years or more in the lower subalpine fir/spruce and upland warm moist western redcedar, western hemlock, and grand fir habitat types and as infrequently as every 330 years or more in the warm/moist and very moist western redcedar and western hemlock habitat types. Collectively these habitat types comprise approximately 91 percent of the NFS lands within the analysis area. Stand-replacing fires were typically very large, often affecting many thousands of acres in a single event (Zack and Morgan 1994; Quigley and Arbelbide 1997).

Successional development of most of the habitat types within the analysis area results in high accumulations of dead woody fuel. Fire was the process primarily responsible for element and nutrient recycling (Zack and Morgan 1994). Non-lethal and mixed severity fires occurred two to three times more frequently than lethal stand-replacing fires. Low-intensity and/or mixed severity fires likely reduced the post fire risk to stand-replacing fire by reducing surface fuels, ladder fuels, and the proportion of fire-intolerant and drought-sensitive tree species within affected stands (Zack and Morgan 1994).

Current stand conditions in stands that have had little or no human management are generally thought to be trending toward higher probabilities of stand-replacing fires (crown fire) than they would have prior to the influence of European settlement (Zack and Morgan 1994; Brown 2000). The reduction of low and/or mixed-severity fire occurrence, selective logging of old fire resistant trees, climatic influences, and wide spread mortality of western white pine due to blister rust have contributed to this trend (Zack and Morgan 1994).

Past forest management included a wildfire exclusion policy intended to facilitate maintenance of a regulated timber supply, increase human safety, and reduce resource losses. Fire suppression efforts to date have been largely successful in holding wildfires to a small average size. The occurrence of larger fires has been reduced by aggressive initial attack of small emerging fires. Fire control, however, is unlikely continue to be effective because of increasing fuels, the predictable occurrence of lightning and occasional multi-season/multi-year drought conditions. Wildfire suppression statistics of the western United States indicate that large, stand-replacing fire occurrence has greatly increased the last 20 years (Calkin and others 2005).

The Fallen Bear Area has had effective fire suppression for nearly 100 years. The drainages analyzed have not experienced stand-replacing fire since the Great Idaho Fire of 1910, and only approximately 8% of the project area burned in 1910.

Fire Occurrence History records are available for the Fallen Bear area for the period 1940-1970 in the form of historical fire atlases. Electronic records are available for the area for the period 1974-2007. A data gap exists for the years 1971-1973. A large-fire burned area map covering the project area is also available in both historical and digitized (GIS) formats. The large-fire burned area map includes data from 1890 to present.

For the period covered by available data (1940-1970, 1974-2007), the following fire history was derived for the project area: There were 26 Lightning fires, 17 of which were Class A fires (less than ¼ acre), and 9 of which were Class B (1/4 to 10 acres). The period 1940-1970 averaged .33 lightning fires per year, and the period 1974-2007 averaged .5 fires per year. There were 3 person-caused fires, two of which were related to logging activities in the late 1960s, and another that was the result of an escaped campfire in 1985. The escaped campfire was a Class A fire, one of the logging fires was a Class B fire, and the remaining logging fire was a Class E fire (300 to 999 acres) that occurred in the NW corner of section 35 in the Bruin Creek drainage in 1967.

The large-fire burned area map shows two areas in which the 1910 fire impacted the project area. Approximately 200 acres of the river face east of Shady Creek burned in 1910, including southern portions of project Units 183 and 183A. Approximately 634 acres of the Haggerty Creek drainage and unnamed river face drainages to the east also burned in 1910, including Units 109, 103, and 96A and 96B in their entirety and portions of Unit 97. The burned area map, which includes data from 1890 to present, displays no other fire activity in the project area.

Table 1 displays the existing fire groups (Smith and Fischer 1997) within the project area and commonly associated fuel models representing natural surface fuel loads. Fuel Model 8 is the timber litter fuel model that burns with the least intensity due to minimal accumulation of dead-down fuel and a compact short needle conifer litter layer. Fuel Model 10 burns more intensely than Fuel Model 8 due to heavy loading of dead-down logs, branch wood, and twigs (Anderson 1982). The amount, distribution, and uniformity of dead down fuels increase as young mixed conifer stands (typically Fuel Model 8) age and progress through stem exclusion stages and seral progression. If mortality occurs rapidly and extensively enough, Fuel Model 10 becomes the prevalent fuel model matrix and Fuel Model 8 occurs as minor inclusions. In the absence of fire, biotic decomposition slowly reduces logs, branches twigs and other litter into duff and soil organic matter. Fuel Model 8 can then eventually become predominate if biotic decomposition occurs more rapidly than dead, down, woody litter accumulation.

Table 1 Acres by Fire Group within the Fallen Bear Project Area

Fire Group	Acres	Dead/Down Fuel Loading (Tons/Acre)	Fuel Model
Fire Group 1	37	4.1 to 10.0	Fuel Models 8, 9, & 10
Fire Group 2	682	3.0 to 16.1	Fuel Models 8 & 10
Fire Group 4	671	2.7 to 12.2	Fuel Models 8 & 10
Fire Group 5	2259	2.4 to 16.8	Fuel Models 8 & 10
Fire Group 7	2320	1.3 to 14.8	Fuel Models 8 & 10
Fire Group 8	4357	13.1 to 53.6	Fuel Models 8 & 10
Fire Group 9	160	0.7 to 38.6	Fuel Models 8 & 10
Unidentified	41	unknown	unknown

Fuel loading values derived from Smith and Fischer (1997)

Vegetative Conditions Related to Past Harvest

The stand history, or activity, data base records the timber harvest that occurred from 1967 to present. Roughly 4,050 acres (38 percent) of the approximately 10,527 acres of National Forest System lands have received some type of commercial timber harvest from 1967 to present. Of this, approximately 64 percent (approximately 2,574 acres) was regeneration harvest (clearcut, shelterwood, and seed tree), and 36 percent (approximately 1476 acres) were treated with intermediate harvests such as sanitation/salvage and liberation/improvement harvest. Stand database records indicate that approximately 1,352 acres of broadcast and jackpot burning have occurred in association with past harvesting and regeneration activities since 1968.

Fire Behavior Factors

Fire behavior is primarily affected by three elements: fuels, weather and topography. Project activities are expected to have a significant effect only on fuels. The natural dynamic vegetation and fuel conditions of the project area eventually lead to stand-replacing fires when conducive climatic conditions coincide with ignition(s). Dead woody fuel accumulation resulting from limb pruning and mortality of trees and shrubs in the absence of periodic low- to moderate-severity fire can result in intense surface fires and crown fire initiation. Other fuel factors promoting initiation of crown fire are low foliar moisture content (Agee and others 2002) and low ground to live crown base height or ladder fuels (Scott and Reinhardt 2001). Continuous aerial extent of closed canopy contributes to sustained crown fire once initiated (Scott and Reinhardt 2001). Seral stand development generally follows a pattern of increasing ladder fuels as shade-tolerant tree species grow underneath seral dominants unless low-severity fire maintains a single-story structure. Ladder fuels reduce the effective ground-to-live crown base height (distance from ground fuels to the live crown) thereby increasing the potential of surface fire to transition to crown fire (Graham and others 2004).

Environmental Consequences

The following graphs briefly compare the no-action alternative and the action alternatives in terms of three fire behavior indicators: flame length, probability of torching, and crowning index. These figures describe one representative stand for each of the following treatments or groups of treatments: shelterwood harvests with subsequent underburn (SW), seedtree harvest with subsequent underburn (ST), and commercial thin with subsequent grapple piling and burning of fuels (CT); and two representative stands the following treatment: clearcut with reserves and subsequent underburn (CC). The solid lines represent the modeled effect of the proposed harvest and fuel treatment(s), while the dashed lines represent the modeled effect of no action. Action versus no action comparisons should be made between solid and dashed lines of like color, as each color represents an individual stand.

Effects vary somewhat between stands depending upon site conditions and other factors. Documents disclosing all inputs and outputs of FFE-FVS modeling runs are available in the project file (FF-01). All of the FFE-FVS results shown were modeled using the default severe weather and fuel moisture scenario in FFE-FVS version 2.02. The

software used was downloaded and installed for use on March 19, 2008 from the FVS website located at: http://www.fs.fed.us/fmsc/fvs/software/setup.php.

Flame Lengths

Flame lengths less than four feet can be safely attacked directly using hand crews. Once flame lengths surpass this mark, other suppression tactics must be employed such as using mechanized equipment, and or burning out from roads, natural barriers, or constructed control lines. In addition, as surface fuels and flame lengths increase, the likelihood of a fire climbing into the canopy to initiate crown fire activity increases. Crown fires, particularly active crown fires that result in complete stand replacement, have the greatest immediate and long-term ecological effects (Graham and others 2004).

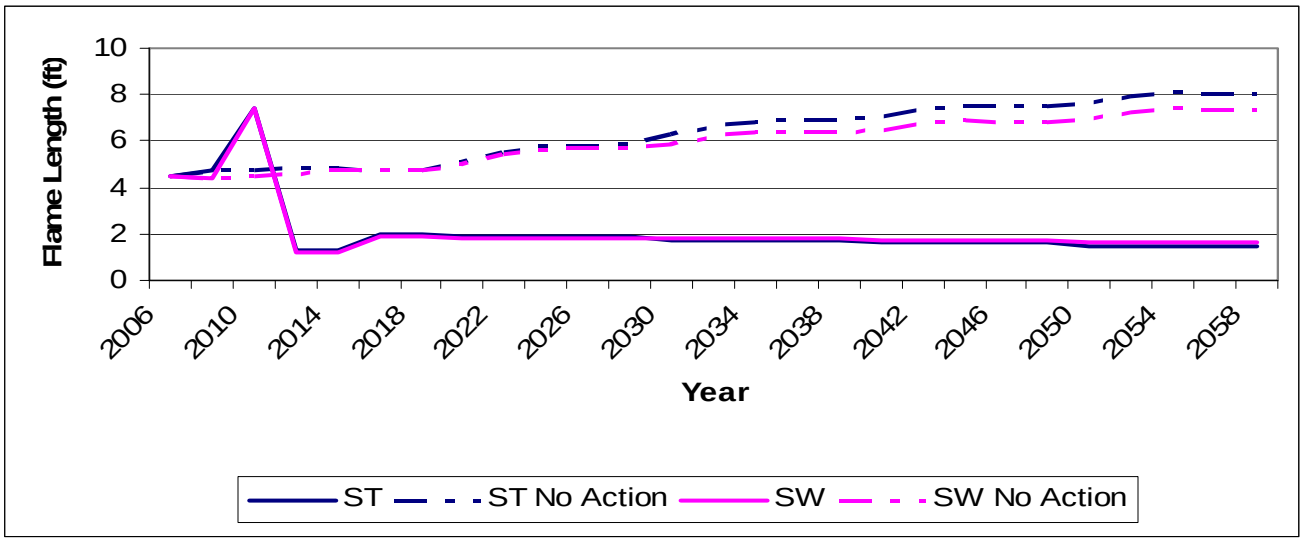

Figure 1 Surface Fire Flame Length Over Time for Representative Seed Tree and Shelterwood Harvests
Note: Solid lines represent treatment, dashed lines represent no action.

Under the no-action alternative, flame lengths increase over time, remaining over 4 feet in response to fuel accumulation. Harvest activities produce increases in flame length following harvest that decrease after prescribed burning. Flame lengths increase again after burning due to the addition of fuels from mortality caused by the burn but remain over the next 50 years below 4 feet.

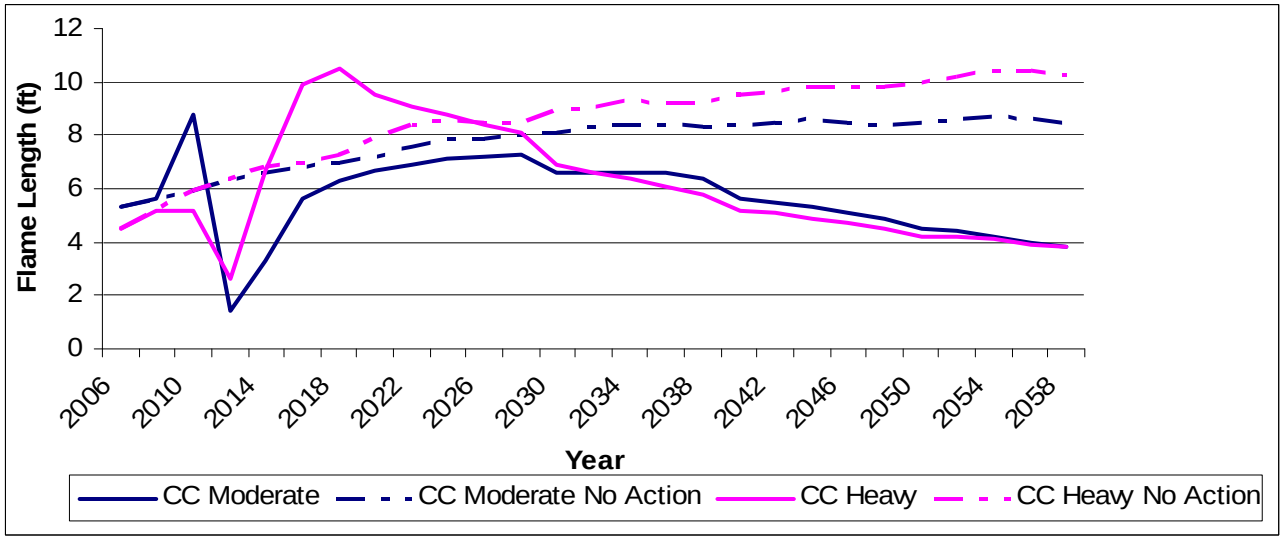

Figure 2 Surface Fire Flame Length Over Time for Representative Clearcut with Reserve Harvests

Note: Solid lines represent treatment, dashed lines represent no action.

Under the no action alternative, flame lengths increase over time, remaining over 4 feet in response to fuel accumulation. Harvest activities produce increases in flame length following harvest that decrease after prescribed burning. Flame lengths increase again after burning in response to fuel accumulations and regeneration and then begin trending downward eventually reaching 4 feet or less.

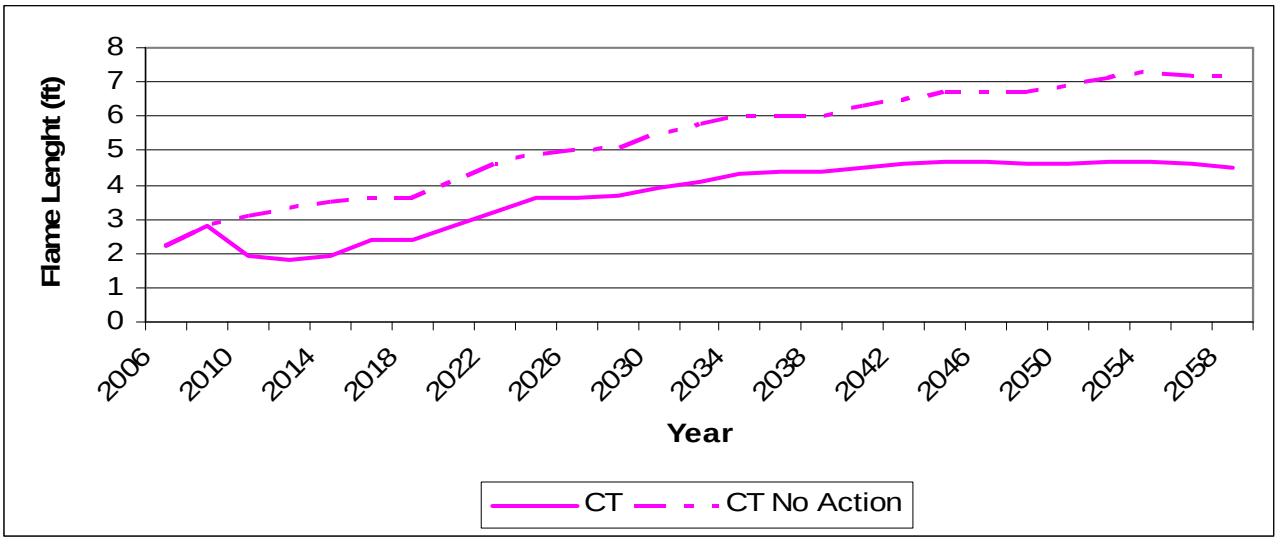

Figure 3 Surface Fire Flame Length Over Time for Representative Commercial Thinning Harvest
Note: Solid lines represent treatment, dashed lines represent no action.

With no action, flame lengths increase over time, reaching over 7 feet in response to fuel accumulation. Commercial thinning causes flame length to increase following harvest. Grapple piling and burning of fuels then causes a reduction in flame length. Flame lengths gradually rebound, primarily due to growth of seedling and sapling trees, which the model includes in the surface fuel profile when projecting fire behavior. Although less than the no action alternative, flame lengths for commercially thinned stands are projected to remain slightly greater than 4 feet for much of the 50 year simulation period.

Probability of Torching

Effects of thinning and regeneration harvests on crown fire behavior are shown in the following figures. The probability of torching is the proportion of small places where trees are present and torching is possible. The higher the probability of torching, the more ladder fuels and the higher the likelihood that the fire will climb into the tree crowns

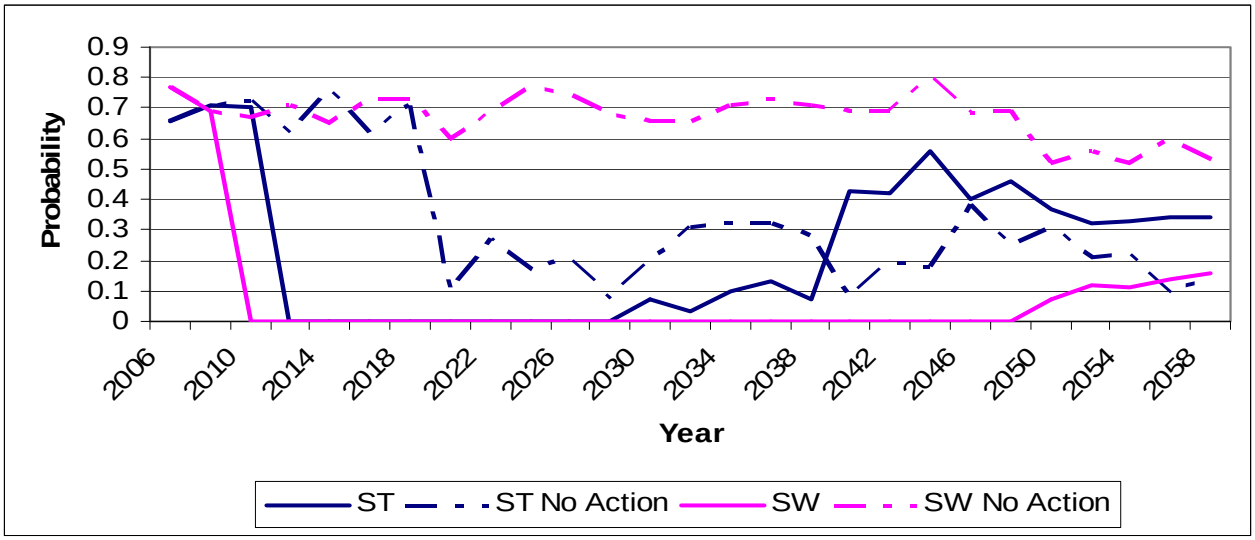

Figure 4 Probability of Torching Over Time for Representative Seed Tree and Shelterwood Harvests

Note: Solid lines represent treatment, dashed lines represent no action.

Both harvests show a dramatic reduction in the probability of torching following harvest. The shelterwood stand shows a clear long-lasting benefit from harvest activities. The seed tree stand shows an eventual increase in probability of torching due to the growth of both planted and artificially regenerated seedlings and saplings. Under the no action alternative the seed tree stand shows some degree of reduction in probability of torching, likely due to natural pruning, but not as much as is realized following the harvest activities.

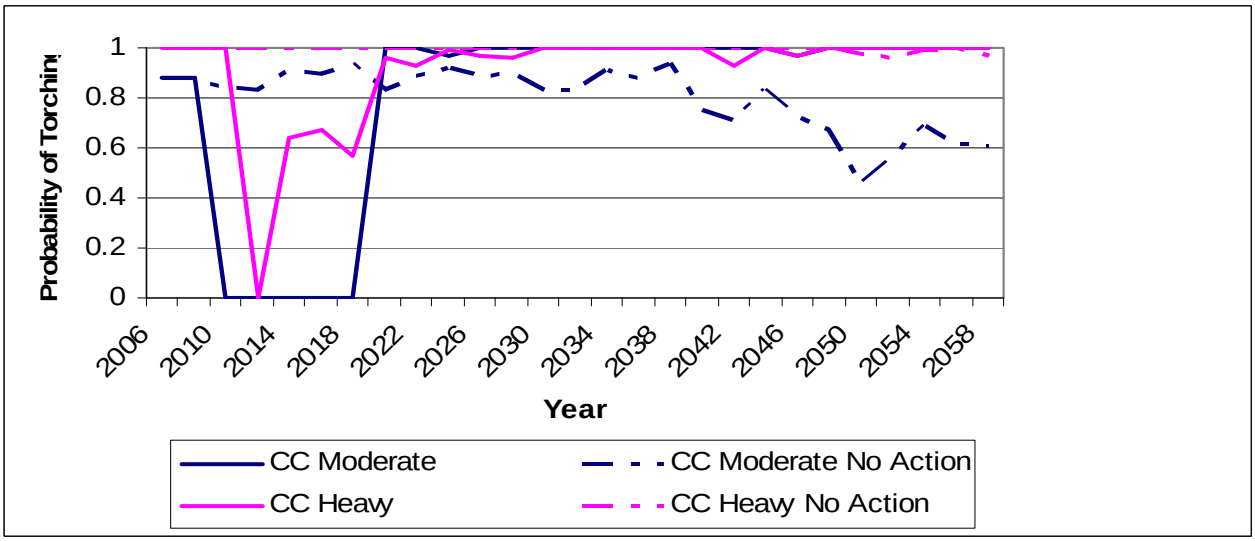

Figure 5 Probability of Torching Over Time for Representative Clearcut with Reserve Harvests

Note: Solid lines represent treatment, dashed lines represent no action.

The clearcuts also demonstrate a dramatic reduction in post-harvest probability of torching. In each case, the probability of torching later rebounds to levels similar or slightly higher than no-action levels. It is important to remember when comparing the alternatives that the probabilities being compared are probabilities of trees in different size classes torching. The probabilities of torching displayed in the no-action alternatives are probabilities of large, mature trees torching. The post-harvest probabilities displayed in the clearcut alternatives are probabilities of the next generation of smaller, younger trees torching.

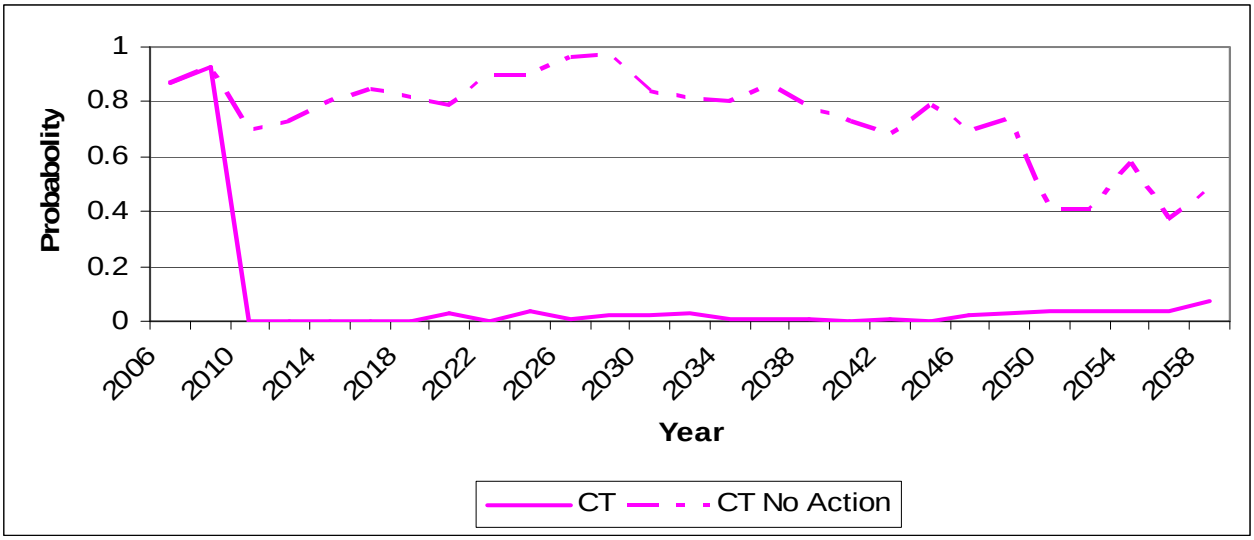

Figure 6 Probability of Torching Over Time for Representative Commercial Thinning Harvest

Note: Solid lines represent treatment, dashed lines represent no action.

The commercial thinning harvests display a very low probability of torching following harvest, and low probabilities are maintained for the duration of the modeling period. Under the no-action alternative the stand maintains values near initial high probability of torching.

Crowning Index

The crowning index reflects the density of the tree canopy and its ability to sustain crown fire. Increasing crown index values indicate less likelihood of sustaining crown fire activity. Conversely lower crown fire indices indicate that less wind is required to sustain crown fire. The effects of the proposed harvesting on crowning index are shown in the below figures.

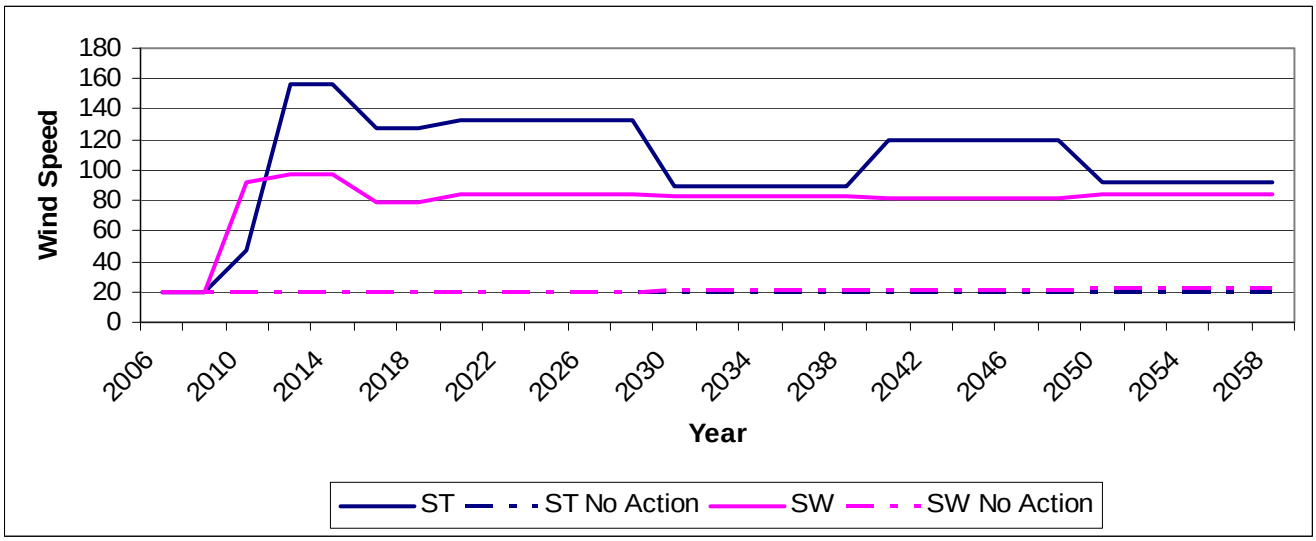

Figure 7 Crowning Indices Over Time for Representative Seed Tree and Shelterwood Harvests

Note: Solid lines represent treatment, dashed lines represent no action

Both types of harvests show substantially increased crowning indices following harvest, reflective of the much higher windspeeds that would be required to sustain crown fire. Both stands show currently low crowning indices that remain over the 50 year period under no action.

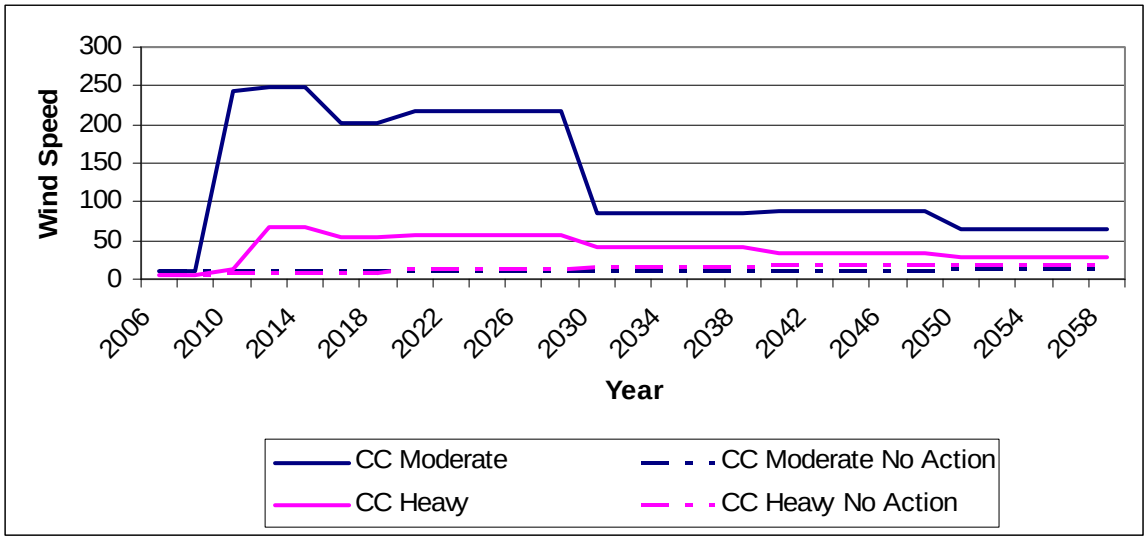

Figure 8 Crowing Indices Over Time for Representative Clearcut with Reserve Harvests

Note: Solid lines represent treatment, dashed lines represent no action.

Both stands modeled show substantially increased crowning indices following harvest, reflective of the much higher windspeeds that would be required to sustain crown fire. Both stands show currently low crowning indices that remain over the 50 year period under no action.

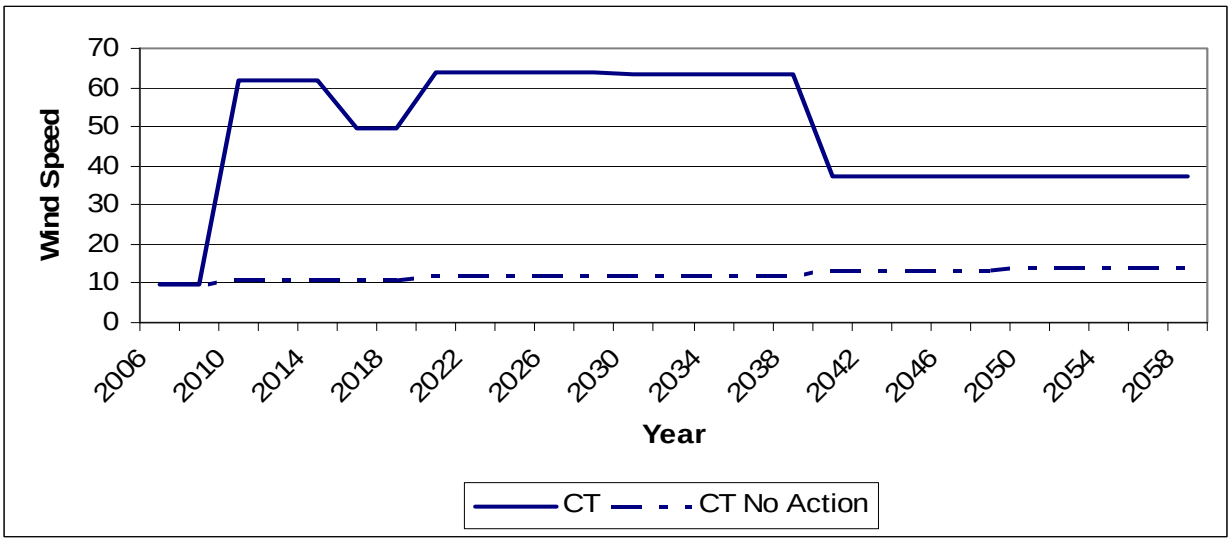

Figure 9 Crowning Index Over Time for Commercial Thinning Harvest

Note: Solid lines represent treatment, dashed lines represent no action.

The stand shows increased crowning indices following harvest. The stand shows currently low crowning indices that are projected to slowly increase over the 50 year period with no action.

The stair stepped appearance of the lines in the figures is a result of, or is enhanced by, the 10-year growth, regeneration, and mortality calculation cycles in the base model, FVS. Growth, mortality, and regeneration in particular, affect the model's choices of representative fuel model, and subsequent modeled fire behavior

characteristics/probabilities. The transitions between time-steps are probably much smoother in reality (Reinhardt and Crookston 2003).

Direct and Indirect Effects of No Action

Continued fire suppression in this alternative would result in continued fuel accumulation and increased fire behavior characteristics, which would subsequently reduce the likelihood of keeping unwanted fires small. Continued fire suppression will eventually result in a deviation from the historic range of variability relative to the occurrence of low and/or mixed severity fires. The effects of excluding natural fire since the early 1900s have affected the ecosystem by jeopardizing long-term retention of early seral conifers and other early seral plants in a fire-created mosaic across the landscape. Harvesting activities occurring since the 1960s that subsequently resulted in the regeneration of western larch and western white pine have contributed to the perpetuation of long-lived early seral species.

Fire suppression efforts within the analysis area cannot be expected to keep all unwanted ignitions small indefinitely. Potential flame lengths are expected to increase in the absence of disturbances such as harvesting, thinning, or fire that change stand characteristics that contribute to crown fire potential. As surface flame lengths increase, potential success of initial attack suppression actions becomes less likely. Figures 1 through 3 show an increasing trend in flame lengths, remaining at or above 4 feet, over the next 50 years in the absence of management activities for all five stands that were modeled. Figures 4 through 6 show that stands currently have, and tend to maintain, a high probability of torching. Figures 7 through 9 show that all five stands that were modeled currently have and maintain crowning indices at or below 20 miles per hour and maintain low values (equating to high crown fire potential) over the next 50 years.

For comparative purposes, archived weather data from the Fishhook remote automated weather station, which is 14 miles west of the Fallen Bear Analysis Area, recorded only 10 daily weather observations between the months of May 1st and October 31st during the years of 1993 through 2007 that were greater than or equal to 20 miles per hour. This data illustrates that the wind speeds needed to support crown fire following the proposed harvest activities in the modeled stands occurs infrequently. In comparison, 427 daily weather records with wind speeds between 6 and 20 miles per hour occurred during the same time period.

Road access for fire suppression would not be affected relative to present levels of access.

Cumulative Effects of No Action

Alternative A would maintain high crown fire indices for at least the next 50 years. Flame lengths would tend to increase over time. Probabilities of torching would tend to remain high or gradually increase from current levels with a few exceptions. Keene and others (2002) provide a discussion of the ecological effects of fire exclusion that contribute to increased fire behavior characteristics. The following is a summary of Keene and others.

Fire exclusion causes forest composition to change from early-seral, shade-intolerant tree species to late-seral, shade-tolerant species, while stand structure changes from single-layer to multiple-layer canopies. An important stand characteristic that changes with advancing succession in the absence of fire is the amount of dead and live biomass or fuels, which tend to increase. Fuel loading generally increases in the absence of fire because of a myriad of ecological factors. First, long fire return intervals allow live fuels longer times to grow and dead fuels longer periods to accumulate on the ground. Next, crown fuels increase because late-seral, shade-tolerant species tend to have more biomass in the forest canopy due to their high leaf areas and because biomass tends to be well distributed over the height of the trees. Stand leaf area generally increases over successional time because shade-tolerant species retain needles longer, have higher leaf-area-to-sapwood ratios, and have more leaf mass in the crown than shade intolerant species. Higher leaf area usually requires additional conducting tissue for support, which means the tree may need to produce more branch and twig wood along greater portions of its stem. Because late seral species are shade tolerant, there are many smaller seedlings and saplings present in the understory to take advantage of any gaps in the canopy. The greater crown biomass distributed along greater parts of the stem, coupled with high seedling and sapling densities, can create the ladder fuels that allow flames from surface fires to climb into the forest canopy and result in crown fires.

Surface fuel loading increases in the absence of fire because the greater crown biomass ultimately results in increased leafy and woody material accumulating on the forest floor in the absence of fire. Dense crowns also reduce the amount of solar radiation that reaches the forest floor, which may lower soil temperatures resulting in decreased decomposition rates and still higher branch and litter accumulations. Duff and litter depths generally

increase proportionate to the crown closure and leaf area because of the additional needle fall and reduced decomposition.

Landscapes tend to become more homogeneous as fire is removed and in the absence of other disturbance because succession eventually advances all stands to similar communities dominated by shade-tolerant species. Even though late-seral species may differ across a landscape depending on site, the multi-layer structures of these late-seral stands are nearly identical across most biophysical settings. Landscape structure (spatial distribution of patches) also changes with fire exclusion as landscapes generally become less fragmented, have lower patch density, and evolve decreased patch diversity, which often results in more contagion, corridors, and large patches. Larger patches and high homogeneity tend to foster more continuous crown and surface fuels, which can then burn in large fires that result in still larger patches.

If human activities associated with recreation increase, then the risk of human-caused ignitions such as abandoned camp fires, vehicle exhaust, and cigarette smoking would also increase; however, most fires occurring in the analysis area have been caused by lightning.

Alternatives B and C

Direct and Indirect Effects

Fuel modification is an effective way to enhance fire control efforts. Fuel modification treatments such as prescribed fire after regeneration harvests, mechanical treatments such as lopping or piling, and commercial overstory manipulation especially thinning from below can reduce fuel loads or alter fuel arrangement (Graham and others 1999; Graham and others 2004;), reduce potential for high-intensity and/or high-severity burns, create fuel breaks (Graham and others 1999), and provide safety zones for firefighters.

Fire has always been an agent of disturbance in the habitat types of the Fallen Bear Analysis Area. In moist forest types, such as those found in the analysis area, the process of structural development in the absence of wildfire reduces stand resiliency to the point of inevitable disturbance. Pre-settlement timber stands had a positive correlation between increased fire frequency and resiliency to fire, drought, and insect stresses. Low, mixed, and high severity fire events contributed to landscape-level vegetative heterogeneity and contributed to the long-term maintenance of early seral species within the landscape (Zack and Morgan 1994; Hessburg and others 2007).

Timber Harvest and Wildfire Potential

The proposed harvest and subsequent activity fuel reduction would affect potential fire characteristics within the treated stands by removing and rearranging existing live and dead fuel loads and by changing the influences of wind, temperature, and relative humidity within the harvested stands (Countryman 1955; Graham and others 1999; Graham and others 2004). The proposed harvesting and fuel reduction activities would facilitate the retention and establishment of long-lived, early-seral tree species. Regeneration harvest with subsequent fuel reduction and site preparation activities would create effective fuel breaks by affecting both surface flame lengths and crown fire indices. Typically the canopy cover and crown bulk density are reduced and the remaining vegetation will not sustain crown fire until conifers reclaim dominance of the canopy. Figures 1 and 2 shows the effects of regeneration harvesting on 3 of the stands proposed for regeneration harvests. The stands representing clearcutting with reserves, shelterwood and seedtree harvesting shows an immediate and significant increase in potential flame length. Subsequent prescribed burning for slash disposal and site preparation reduce potential flame lengths to 2 to 5 feet for the rest of the period shown. The effects of retaining varying amounts of canopy on surface wind speed are clearly displayed by the variation in flame lengths over time in the harvesting scenarios. Clearcutting retains the least canopy, allowing the greatest increase in surface wind speed while commercial thinning retains the most canopy (amongst the harvesting scenarios) allowing comparably greater reduction of surface wind speed which directly influences flame lengths.

The probability of torching is immediately reduced in all harvests (Figures 4 through 6) through either elimination of canopy (clearcutting) or removal of ladder fuels, increasing crown base height, decreasing fuel bed depth, and/or reducing fuel loading. The effects of regeneration establishment are apparent in the probability of torching projections for the regeneration harvests. As regeneration becomes tall, 10 to 30 years post harvest depending on harvest method, the model shows an increase in the probability of torching even though flame lengths are decreasing. The decrease in flame lengths is due in part to decomposition of fuels, but most likely to the reduction of surface wind speed due to the establishment of canopy. The probability of torching increases because of the increased area having trees with crowns near the ground that are also considered the primary overstory. This pattern is consistent with discussions of severe burns in young post-disturbance stands reported by Zack and

Morgan (1994) and Thompson and others (2007) that were attributed, in part, to the short, dense, and continuous crown cover of the artificially planted or naturally regenerating forest.

Crowning indices are increased by harvesting activities in all four modeled stands and are maintained at values greater than about 20 miles per hour or over the remainder of the fifty years past the simulated harvest and fuel reduction activities.

The action alternatives include site preparation and slash disposal activities using prescribed fire, excavator piling, yarding of tops, and lopping. Yarding tops, lopping, and grapple piling would be completed at the time of harvest by the timber sale purchaser. Pile burning and prescribed burning activities is scheduled for the three years after harvest completion but in all cases would occur within five years after harvest activity completion because funding collected from the timber sale must be used to accomplish timber sale related activities such as prescribed burning for site preparation and/or slash disposal within five years of timber sale closure.

Prescribed burning would be conducted under conditions specified in a prescribed fire burn plan, and would follow design features (see design features in the Fallen Bear EA) and silvicultural prescriptions. Prescribed burning is intended to maximize resource benefits. Prescribed fires would be generally low-severity and low to moderate intensity burns for fire hazard reduction and/or site preparation for regeneration. Burning would occur when conditions are conducive to short-duration fires with little chance of escape. The result would be reduction of fine fuel loads resulting from harvest activities and subsequent fire hazard.

Harvest activity serves to maintain fire suppression access through maintenance of existing roads and by altering fuels and fire behavior within harvested stands and, therefore altering landscape-level horizontal and vertical fuel continuity. Regeneration harvests create a short-term increase in fire hazard until the site preparation and hazard reduction burning is accomplished. Regeneration harvests may result in a on-site fuel loading of up to 30 tons/acres of fine fuel (less than 3 inches diameter) until prescribed burning is accomplished.

Timber harvesting on these sites reduces probable near-term accumulations of natural fuels. Harvest activities, as proposed in this project, would immediately increase fuel loading. Subsequent fuel reduction treatments such as grapple piling and burning, jackpot burning, or broadcast burning would reduce the fuel loads within five years of harvest. Alternative B includes 196 acres in which lopping is the only slash treatment. Alternative C includes 139 acres in which lopping is the only slash treatment. More intensive slash disposal treatments (yarding tops, grapple piling, or prescribed burning) are not prescribed for these units due to one or more of the following factors: 1) fire intolerant species would still be heavily represented in the stand following harvest, 2) a majority of the species in the stand would be fire tolerant but would be too small to survive prescribed burning, 3) slopes are too steep for grapple piling, 4) there is no road access for mechanized equipment, or 5) retention of slash is desired for the purpose of nutrient cycling.

Direct effects on wildfire potential were analyzed in relation to the proposed harvest and hazard-reduction activities within stands proposed for activity. Harvest activities may decrease or increase potential fire hazard depending on residual stand characteristics and combined pre-existing and activity-generated surface fuel loads. Portions of harvest units where post-harvest fuel loads exceed acceptable levels may have one or more fuel reduction treatments prescribed. The analysis includes silvicultural treatments that propose site preparation/hazard reduction burning or that reduce fuels by yarding tops during harvest, lopping, burning, and/or excavator piling.

Quick shrub growth and conifer regeneration is expected to reestablish solar and wind sheltering of surface fuels within 5-10 years in regeneration harvests with a corresponding reduction in fire behavior potential. In the moist forest type, grass fuels, which have higher potential rates of fire spread than low shrub or litter fuels rarely dominate regeneration harvest areas (Anderson 1982).

Table 2 Summary of Fuels Treatment by Alternative

Treatment	Alt. A	Alt. B	Alt. C
Broadcast Burning	0	202	112
Grapple Pile	0	62	28
Lopping	0	196	139
Yard Tops	0	34	28

Research indicates that reduction of crown bulk density by pre-commercial thinning of the overstory reduces potential for active crown fire initiation and spread, especially when combined with low potential surface fire intensity (Scott 1997). However, slash resulting from pre-commercial thinning activities increases fire hazard within thinned stands until it is incorporated into the forest floor by snow compaction and decomposition. The increased hazard gradually decreases as the needles and fine twigs fall from the slash, reducing but not eliminating the elevated hazard. Increased fuel loading resulting from pre-commercial thinning slash, by comparison, would be less than for the commercial thinning harvest. This is because the size of the trees felled is much smaller in stands

proposed for pre-commercial thinning than it is for those in the stands proposed for commercial thinning. Pre-commercial thinning would occur on 775 acres in both of the action alternatives. Slash resulting from pre-commercial thinning would be lopped to a depth of no greater than two feet.

Commercial thinning (CT) reduces potential fuel accumulation by promoting healthy stands and by reducing ladder fuels associated with hemlock and true firs through preferential selection of these species for harvest within the proposed units. The fire resiliency of these stands would improve so long as the surface fuel hazard is not substantially increased by the harvest activities or is reduced after harvest activities are complete. CT reduces crown bulk density and can reduce potential crown fire initiation and spread as long as increases in potential surface fire intensity caused by harvesting residue (slash) do not overshadow the gains of crown bulk density reduction. Project design includes yarding tops, lopping, grapple piling, and broadcast burning to minimize potential increases in post-harvest surface fire intensity and/or severity (see description of each alternative in the Fallen Bear EA for type of fuels treatment associated with each unit).

Areas that are commercially thinned and only have lopping prescribed would initially have greater surface flame lengths than they had prior to harvesting due to increased surface fuel loading, increased solar insolation, and decreased wind sheltering due to decreased canopy cover. Lopping does not reduce post harvest activity fuel loading. It does however, reduce the depth of the post harvest fuel bed and increase the compaction, or density, of the activity fuels. Therefore, lopped fuels exhibit less intense fire behavior characteristics than unlopped fuels even though fuel loading is not affected. Lopped fuels should also decompose more readily than unlopped fuels because they are closer to the forest floor where biotic decomposers can more readily affect them. Commercial thinning, regardless of slash treatment method, reduces the probability of torching (Figure 4) and increases the crowning index (Figure 6) .

Timber harvest would promote conditions for safe and effective wildland fire management in the project area by affecting live and dead fuels in ways that are beneficial to fire management. The harvest openings with slash treatment would provide distinct reductions in potential fire behavior, which would provide tactical advantages in managing any kind of fire. Harvested areas would be long-term fuel breaks, providing perimeter control options for fire managers during future wildland or prescribed fires. The thinning and partial cuts would increase possibilities of future prescribed fire application in these areas. Commercial thinning with subsequent grapple piling of fuels, would mimic low- to moderate-intensity fire effects on structure and composition. Commercial thinning would also reduce live fuel loadings to levels that are more advantageous to future stand maintenance and/or resilience to fire and other pathogens. When analyzed at the watershed scale, Alternative B is expected to provide more positive benefits than Alternative C due to the greater amount of fuel treatments and increases in access due to road construction.

The proposed road decommissioning would reduce the potential for roadside human-caused ignitions by reducing accessibility. The proposed road decommissioning may result in an increase of the average cost per acre for fire suppression within the areas affected by reduced motorized access. This would be due to reduced access for fire engines and water tenders, increased response-times and potential increases in the use of aerially-delivered firefighters and supplies. In contrast, the proposed harvesting would provide opportunities to utilize changes in fuel types as natural barriers to fire spread that may allow managers to provide for an increase in firefighter safety, more readily reduce suppression costs, reduce disturbance associated with traditional suppression actions, and/or realize resource benefits from wildfires in accordance with fire management plan direction.

Cumulative Effects

Cumulative effects are those that would result from the action alternatives in addition to the incremental impacts of past, ongoing and reasonably foreseeable activities. Fire suppression has been effective in the Fallen Bear Analysis Area for nearly 100 years. The incremental effect of suppressing each small fire in the watershed, over time, has promoted late seral species rather than early seral species, thereby changing forest structure and, in turn, changing the way the ecosystem responds to fires (Zack and Morgan 1994). The existing road network, a result of previous road construction, has enhanced fire suppression efforts. Past harvesting, the effects of the 1910 fire, and the impacts of white pine blister rust, in combination have resulted in an under representation of large, old, early-seral species within the analysis area (see Forest Vegetation Report). The improved growth of existing early-seral trees through commercial thinning would contribute to the reestablishment of large, old, western white pine and western larch over time. Reforestation efforts after regeneration harvests would also focus on the reestablishment of healthy populations of fire-resistant early seral species.

Because of the improvements in crowning index, flame length, and probability of torching over time realized in managed stands, containment and confinement opportunities (where permitted) would improve for fire managers

responding to unplanned ignitions in the future. The projected reductions in flame length and probability of torching would also improve opportunities for application of prescribed fire within the treated stands as the growth of trees improves their likelihood of surviving light underburning. Areas that would be treated under the action alternatives are relatively small in comparison to the project area in it's entirety, however the positive effects realized would be enhanced in many cases due to the spatial relationships between treatment units and areas of previous management activities.

Table 3 – Consideration of Past, Present, and Reasonably Foreseeable Activities for Cumulative Effects

Action	Past	Present	Future	May Have Cumulative Effects	Explanation
Timber Harvest	**X**			**Yes**	Past management activity served to reduce fuel loadings and diversify landscape, both effects carry forward.
Tree Planting	**X**			**Yes**	Past management activity served to restore fire-resilient species to landscape.
Precommercial Timber Stand Improvement	**X**			**Yes**	Past management activity served to reduce fuel loadings and diversify landscape, both effects carry forward.
Mechanical or Manual Site Preparation & Fuels Treatment	**X**			**Yes**	Past management activity served to reduce fuel loadings and diversify landscape, both effects carry forward.
Prescribed Burning for Site Preparation & Fuels Treatment	**X**			**Yes**	Past management activity served to reduce fuel loadings and diversify landscape, both effects carry forward.
Prescribed Burning for Wildlife Habitat Improvement	**X**			**Yes**	Past management activity served to reduce fuel loadings and diversify landscape, both effects carry forward.
Wildfires	**X**		**unknown**	**Yes**	Large wildfires helped to reduce fuel loading and diversify landscape.
Fire Suppression	**X**	**X**	**X**	**Yes**	Continued fire suppression serves to delay inevitable large fire events by contributing to fuel buildup and stand density.
Clearing Brush & Trees to Maintain Helispots	**X**	**X**	**X**	**NO**	
Road Construction	**X**			**NO**	
Road Decommissioning	**X**			**Yes**	May increase cost of fire suppression and final fire sizes by increasing response times.
Road Maintenance	**X**	**X**	**X**	**NO**	
Conrad Campground	**X**	**X**	**X**	**NO**	
Public Activities: firewood cutting, driving roads, camping, snowmobiling, hunting, hiking, berry picking, fishing,	**X**	**X**	**X**	**NO**	

Action	Past	Present	Future	May Have Cumulative Effects	Explanation
Christmas tree cutting					
Trail Construction	**X**			**NO**	
Trail Maintenance	**X**	**X**	**X**	**NO**	
Fisheries Habitat Improvement Projects	**X**			**NO**	
Spraying Herbicides to Control and Prevent Noxious Weeds Under the St. Joe Noxious Weed EIS	**X**	**X**	**X**	**NO**	
Outfitter and Guide Uses	**X**	**X**	**X**	**NO**	
Large woody debris removal from Bruin Creek	**X**			**NO**	
Flood damage & repair on Bruin Creek Road in 1997	**X**			**NO**	
Eureka Mine hard rock mining	**X**			**NO**	
Installing bat-friendly barrier on Eureka Mine adit to block human access for safety			**X**	**NO**	

If human activities associated with recreation increase, then the risk of human-caused ignitions such as abandoned camp fires, vehicle exhaust, and cigarette smoking would also increase; however, most fires occurring in the analysis area have been caused by lightning.

The action alternatives would reduce the potential for ignitions from any source to result in undesirable effects within the project area. Alternative B has a greater potential to reduce future undesirable effects from wildfire than Alternative C due to the greater amount of fuel treatments and increases in accessibility. Project features such as fuel reductions that reduce potential for undesirable wildfire effects will maintain effectiveness regardless of future fire management strategies. Project features such as increases in accessibility that enhance effectiveness of wildfire suppression will be effective as long as fire suppression strategies are implemented in the project area.

Consistency with Forest Plan and Laws

Prescribed burning and mechanical treatment of activity fuels proposed in both action alternatives are consistent with direction in the Forest Plan and the Idaho Forest Practices Act.

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