FOREST VEGETATION SILVICULTURIST REPORT FOR THE BEARTOOTH FRONT STORM DAMAGE CLEAN-UP AND FUELS REDUCTION PROJECT IN THE BENBOW AND MAIN FORK OF ROCK CREEK

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Custer National Forest
Northern Region

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BACKGROUND

This project proposes to improve public and firefighter safety, clean up areas of wind damaged trees, improve defensible space around structures and reduce fuel loading on Forest Service lands in the Main Fork Rock Creek and the Benbow area (Little Rocky Creek drainage) located in Carbon County of Montana.

On November 12, 2007 a wind event with over 100 miles per hour gusts resulted in widespread damage across the Beartooth Front of the Beartooth district of the Custer National Forest. Damage to trees included uprooting, partial uprooting, leaning, and wind snapped trees. Concentrations of this wind damage have caused concerns over potential increases of beetle populations which could further add to the hazardous fuel loads. Another concern identified was increased susceptibility of wind damage after implementation of proposed treatments. A compiled Environmental Assessment (EA) will discuss the findings of the analysis conducted for the Beartooth Front Storm Damage and Fuels Reduction Project by individual specialist assigned to the project. This report will describe the proposed treatments in detail and discuss the effects on the forested resource as it relates to a potential beetle population increase, wind damage risk post treatment and effect post treatment regeneration has on potential fire. This report will be filed in the project file located at the Beartooth district office, Red Lodge, Montana.

PROJECT AREA DESCRIPTION

The project treatment areas consist of approximately 614 acres. The treatment units are in 2 separate areas Main Fork of Rock Creek (237 acres) and Little Rocky Creek (377 acres) drainages. The Main Fork Rock Creek area is approximately 9.5 miles south-southwest of Red Lodge. The Benbow area is in the Little Rocky Creek drainage, approximately 35 miles northwest of Red Lodge and 3 miles west of Dean, Montana.

PURPOSE AND NEED

The primary purpose of the project is to improve firefighter and public safety by reducing fuel loads and fuel continuity in the project area. Secondary objectives include: timber stand improvement, wood product removal, soil and watershed improvement, and wildlife habitat enhancement. This would be accomplished by the use of management tools such as mechanical commercial, manual or mechanical non-commercial treatment and prescribed fire to move affected treatment areas towards their desired condition consistent with the management area goals and standards in the Forest Plan.

Identified needs for this project included: improving public and firefighter safety in the Main Fork Rock Creek and Little Rocky Creek drainages and improving overall defensible space around the communities of Red Lodge, Dean and associated infrastructure on private and public lands. Initially these needs were determined to be addressed by reducing fuel loads, creating fuel breaks, increasing defensible space around building, reducing beetle infestation potential and constructing a West Fork safety zone.

Forest Vegetation and Fuel Loads

The November 2007 wind event resulted in heavy concentrations of trees blowing over or being damaged in the Main Fork Rock Creek and Benbow areas. When combined with fuel loads that existed before the storm, these trees form areas of down fuel that will readily carry a fire.

Concentrations of wind damaged and fallen trees can increase bark-beetle infestation potential. Such concentrations can attract beetles from surrounding areas. Wind damaged and fallen trees serve as food sources and over-wintering habitat for several bark beetles, including mountain pine beetle, engraver beetles, western balsam beetle, Douglas-fir beetle, and spruce beetle. Mountain pine beetle will not attack down trees but may attack weakened trees (i.e. partially uprooted trees still alive).

Beetles kill live trees by breeding and laying eggs in the phloem (or vascular tissue) of trees, which transports water and nutrients to the tree. The subsequent feeding as the beetle goes thru its life cycle in the phloem cuts off the life support flow of water and nutrients to the tree.

When abundant host trees (such as fallen, damaged weakened trees) are present, beetle populations can increase and may exhaust that food supply and then can inhabit and kill nearby live healthy trees. Population increases are largely a function of weather, vigor of trees, host material size and availability. Continued drought tends to make trees less vigorous and more prone to beetle attack. In general, cool, wet weather will reduce outbreak potential, while warmer, dryer than normal conditions will increase potential.

The most recent aerial survey (2007) identified a few small and very scattered groups of mountain pine beetle killed lodgepole pine and Douglas-fir beetle killed Douglas fir across the Beartooth district (Gibson, 2008). Mortality of lodgepole pine from mountain pine beetle has had highest amounts mapped in 2005 with 4,700 trees killed in 2007 (Meyer, 2005; Gibson, 2008). Mountain pine beetle killed whitebark pine has been much more prevalent. In 2007 some areas on the district several hundred whitebark pine trees have been killed. Aerial surveys from 2001 to 2007 have indicated the highest levels of beetle mortality are from the western balsam bark beetle in the sub alpine fir spruce stands. This mortality has steadily increased since 2001. In 2001 total trees killed was 1,350, in 2002 1,560 trees, in 2003 3,200 trees, in 2004 8,300 trees and in 2007, 16,800 trees (DeNitto, 2002; Meyer, 2003; Meyer, 2004; Meyer, 2005; Gibson, 2007). No spruce beetle killed trees have been identified from 2001 to 2007.

Aerial surveys have detected and mapped small scattered populations of mountain pine beetle in the Little Rocky Creek and Main Fork drainages. If beetle infestations increase at and near wind-damaged areas, they could potentially kill live trees, which could increase fire risk as the amount of fuel increases.

The health and condition of the forested ecosystems varies across the project area. There is a need to reduce tree densities, ladder fuels and crown canopy within the conifer dominated forested stands to decrease the risk of fire reaching the overstory canopy and

being sustained as a crown fire, resulting in a large stand replacement event. Achieving these conditions would reduce competition of light, nutrients and water and restore the diversity, vigor, composition and structure of the forested stands, while maintaining endemic levels of insect and disease. The existing condition has resulted in, part from lack of disturbance (management or natural). Subsequent development of high tree densities promotes insect infestations and disease infections, which result in tree growth reductions, physical deformities, and mortality. These factors have reduced the health, vigor, and productivity of the forested ecosystems. High tree densities have increased natural fuel loading, and the risk of stand replacing wildfires. The lack of disturbance in some cases has fostered the development of multi-storied and/or dense, full canopied stands, which causes a decline in the understory shrub, herb and grass species. This decline, mainly due to shading, is demonstrated in some cases by the absence of the understory grass, forb and shrub vegetative components in the very dense stands. This decrease in the understory components has a negative effect on the nutrient cycle. Understory components with their yearly leaf fall and dieback, enable nutrients and important defense mechanisms against insect and disease attack, to be cycled through the systems. The desired condition is to reduce tree densities, remove the stagnant forested understory, and decrease the risk for epidemic insect infestations and disease infections. This condition would promote a healthy, structurally diverse, productive and vigorous growing forested ecosystem. The reduction of crown canopy would also promote the release of the browse component.

Historically, lightning-caused fires reduced fuels on the Beartooth Ranger District. Computer modeling simulations indicate the Beartooth Front is characterized by high severity fires every 35 to 200 or more years. From 1870 to 1904, more than 138,000 acres of forest land burned on the Beartooth District, including the West Fork drainage.

Considerable growth of timber in the former fire area has occurred since the fires of the early 1900's. Fire suppression and development of homes and cabins in the project areas have prevented wildfire from performing its natural role in fuels reduction. Forests in the project areas are primarily even-aged mature lodgepole pine. Lodgepole forests that survive more than about 100 years often become susceptible to and die from mountain pine beetle infestations. The resulting buildup of dead and dry fuels can invite a large stand-replacing wildland fire. There are also spruce, Douglas-fir, aspen, sub alpine fir, and whitebark pine forests. In general, these forest types are also susceptible to beetle infestations and stand-replacement fires. Crown fires can readily spread into these forest types from adjacent lodgepole forests.

Since the 1940's, 70% of all fires on the Beartooth Ranger District have been human-caused and 43% of these fires were in the West and Main Forks of Rock Creek. Since 1949, 78% of all fires in the upper and lower portions of the West Fork drainage have been human caused. Most historic human-caused fires on the Beartooth District occur in drainage bottoms where recreational use is more frequent.

Climatic and terrain influences
During dry periods, lightning started fires are a regular occurrence. Trees weakened by drought can also become more susceptible to insect infestations. For most of the past 10 years, summer precipitation has been below historic levels. Recent drought in Stillwater and Carbon Counties has significantly heightened risk of wildland fire along the Beartooth Front. Live fuel moistures over the past few years have been lower than normal on the Beartooth District. Live and dead forest fuel moistures on the District have been recorded since the 1970's and are used to calculate Energy Release Component (ERC) for wildland forest fires. Higher ERC values indicate higher potential wildland fire severity. In general, larger fires (≥1000 acres) tend to be associated with higher ERC values. Large fires can be quite expensive and dangerous. Over the past several years, peak summer ERC values have been exceeding historic high values on the Beartooth Ranger District. Strong wind events similar to the November 2007 wind event are common in Stillwater and Carbon Counties. Some of the Main Fork and Benbow areas are characterized by steep, forested, and wind-prone slopes. In addition to potential for storm damage to trees and increased fuels loads, there is rapid wildland fire growth potential. The Beartooth Mountains consist of large plateaus and steep, narrow drainages. Steep slopes affect fire ignition and spread by preheating the fuels upslope and enabling spotting to occur from rolling and aerial fire brands. Narrow drainages, including the Main Fork and Benbow, can funnel winds down slope from the plateaus and increase wind speeds. Flame length, rate of spread, and fire spotting generally increase with wind speed.

In the past 20 years, strong winds, topography and high ERC values have resulted in rapidly spreading high intensity fires on Custer National Forest lands in Carbon and Stillwater Counties. Examples include the 2006 Derby fire (200,000 acres), the 2002 Red Waffle fire (2,000 acres) in 2002, the 2000 Willie Fire (1,503 acres), the 1996 Shepherd Mountain fire (14,890 acres), and the 1988 Storm Creek (56,856 acres) and Clover/Mist Fires (387,400 acres).

PROPOSED ACTION
The Beartooth Ranger District, Custer National Forest, proposes to move portions of the forested ecosystems toward their desired conditions in Main Fork Rock Creek and Little Rocky Creek drainages. Hazardous fuels reduction would be accomplished through the tools of timber harvest, thinning, and prescribed burning to restore or maintain the structure, function, and composition of forested systems across the treatment areas. The proposal may reduce the quality of wildlife habitat for the short-term but would ensure the long-term diversity and quality of habitats for selected species and provide wood products from the area, consistent with Forest Plan direction.

The proposed action is to treat approximately 614 acres. Approximately 356 acres would be treated by mechanical means in the forested area which was identified as suited for commercial timber harvest. About 258 acres would be non commercially thinned by a combination of manual and mechanical means followed by piling of fuels and burning of piles. These treatments will reduce ladder fuels, tree densities, crown cover and maintain surface fuels at acceptable levels. Silvicultural prescriptions will be designed to

minimize impacts, improve and/or retain wildlife habitats, alter current forest structures to enhance our ability to manage fires, and provide for wood products removal. See tables below for treated acres by project area and detailed treatment descriptions.

TABLE: TREATMENT TYPE ACRES BY PROJECT AREA

Activity	Benbow	Main Fork Rock Creek	Total Acres[1]	Fuels Treatment
Commercial Harvest Treatments (Mechanical**)**				
Commercial Thinning *inclusive of salvage of wind damaged trees when present*	289.9	0	289.9	Whole tree logging, burn landing piles
Clearcut Harvest *inclusive of salvage of wind damaged trees when present with* ***Site Preparation for Natural Regeneration***	66.2	0	66.2	Whole tree logging, burn landing piles
Commercial Totals	**356.1**	**0**	**356.1**	
Non Commercial Treatments (Mechanical/Non mechanical)				
Non Commercial Thinning *includes slashing of wind damaged material*	20.7	200.5	221.2	Hand or Machine pile, burn piles
Slashing *of wind damaged material*	0	37.1	37.1	Machine pile, burn piles
Non Commercial Totals	**20.7**	**237.6**	**258.3**	
Project Area Totals	**376.8**	**237.6**	**614.4**	

[1]These are approximate acres derived from Forest GIS coverage's. [2]7.3 of the aspen acres are included within other treatment acres. [3].05 acres of willow treatment are included within other treatment acres.

Actions connected to the proposed action may involve construction of temporary roads and reconstruction of existing roads (necessary for haul), timber harvest, restoration of aspen and willow ecosystems, slashing, thinning, hand piling, machine piling, site preparation, and prescribed fire (burning of piles) within the forested and non forested ecosystems. In addition, the proposed action could reduce the risk of a large fire event, and reduce the incidence of epidemic levels of insect infestations and disease infections within the project area.

The harvesting of timber, thinning, prescribed burning, and construction and reconstruction of roads will be analyzed in accordance to the standards and guidelines identified in the Forest Plan, as well as, other requirements of pertinent Federal and State laws and regulations. These may include, but are not limited to, the National Forest Management Act, Endangered Species Act, Clean Water Act, National Historic Preservation Act, and State Water Quality Standards.

Adjustments in livestock stocking levels or season of use would be addressed during the allotment planning process under a separate analysis and National Environmental Policy Act (NEPA) decision.

The Interdisciplinary Team may identify additional resource concerns based on the environmental assessment of the project area. Resource concerns identified may require mitigation measures to reduce the level of impacts or effects on a particular resource located with the project area. Changes may result in limiting treatment activities or their intensity due to these measures.

TABLE: PROPOSED BENBOW TREATMENT UNITS

Treatment #	Unit #	Cutting Treatment Activity	Commercial Non Commercial	Treatment Method	Hazardous Fuels Treatment Details (Harvest/Thinning)	Activity and Natural Fuels Treatment Details	Post Treatment Down Woody Fuel Load Desired Conditions
1,2	1, 58	**Salvage Harvest, CC with Reserves and Commercial Thinning**	Commercial	Machine	Where operable: **Salvage** storm damaged material. Remove wind thrown, uprooted, and standing trees that have broken tops, major bole damage or are leaning. **Clear Cut with Reserves** - Due to the heavy storm damage there is no manageable stand left on northern portion of unit 1 (60 to 80 %) and southern portion of unit 58 (60 to 80%), these areas will need regenerated. North end may not be operable for machinery due to riparian area. Remove storm damage material, leaving individual trees that are not damaged or expected to die in the next five years as a seed source. **Thin** remaining live trees - Small strip (300 to 500 feet) along road and other less damaged portions of the stand will be thinned. Thin from below to remove ladder fuels and create a 10 foot crown spacing (approximately 20 to 30 feet bole spacing in trees greater than 5" dbh and 15 to 25 feet in trees less than 5" dbh). **Site preparation for natural regeneration** – mechanical or burning. Expose 15 to 30% bare mineral exposure to ensure favorable conditions for adequate seedling establishment.	**Whole Tree Log** Remove and pile non merchantable material and tops down to desired fuel loads. Slash left on site - Buck tree boles 6" and greater to 6 foot lengths and lop all slash to an 18 inch slash height. **Burn landings**	Down Fuels tons per acre ≤ 10 tons per acre. 1 to 3 tons in the < 3 inch size class and 7 to 9 tons in the > 3 inch size class.
		Slashing Thinning	Non Commercial	Machine Hand	Portions of unit are inoperable for logging machinery or have no merchantable material. **Slash** storm damaged material (wind thrown, uprooted, and standing trees that have broken tops, major bole damage or are leaning). **Thin** remaining live trees - Thin from below to remove ladder fuels and create a 10 foot crown spacing (approximately 20 to 30 feet bole spacing in trees	**Hand or Machine Pile** down to desired fuel loads. Hand piles should be compact, maximum 8 feet high, 6 to 8 feet in diameter, and 10 to 15 feet from live trees to minimize damage. Machine piles should be compact a minimum 20 feet from live trees, utilizing openings or clearing small openings and limited in	Down Fuels tons per acre ≤ 10 tons per acre. 1 to 3 tons in the < 3 inch size class and 7 to 9 tons in the > 3

Treatment #	Unit #	Cutting Treatment Activity	Commercial Non Commercial	Treatment Method	Hazardous Fuels Treatment Details (Harvest/Thinning)	Activity and Natural Fuels Treatment Details	Post Treatment Down Woody Fuel Load Desired Conditions
					greater than 5" dbh and 15 to 25 feet in trees less than 5" dbh). **Site preparation** – mechanical or burning. In areas where there is not a manageable component expose 15 to 30% bare mineral exposure to ensure favorable conditions for adequate seedling establishment. Cut merchantable trees could be sold.	height to minimize damage to live trees. Slash left on site - Buck tree boles 6" and greater to 6 foot lengths and lop all slash to an 18 inch slash height. **Burn Piles**	inch size class.
1,2	2, 3,54,56,57, 60	**Salvage Harvest Commercial Thinning**	Commercial	Machine	Where operable: Salvage storm damaged trees, followed by thinning **Salvage** - Remove wind thrown, uprooted, and standing trees that have broken tops, major bole damage or are leaning. **Thinning -** Thin from below to remove ladder fuels and create a 10 foot crown spacing (approximately 20 to 30 feet bole spacing in trees greater than 5" dbh and 15 to 25 feet in trees less than 5" dbh)	**Whole Tree Log** Remove and pile non merchantable material and tops down to desired fuel loads. Slash left on site - Buck tree boles 6" and greater to 6 foot lengths and lop all slash an 18 inch slash height. **Burn landings**	Down Fuels tons per acre ≤ 10 tons per acre. 1 to 3 tons in the < 3 inch size class and 7 to 9 tons in the > 3 inch size class.
		Slashing Thinning	Non Commercial	Machine Hand	Portions of unit are inoperable for logging machinery or have no merchantable material. **Slash** storm damaged material (wind thrown, uprooted, and standing trees that have broken tops, major bole damage or are leaning). **Thin** remaining live trees - Thin from below to remove ladder fuels and create a 10 foot crown spacing (approximately 20 to 30 feet bole spacing in trees greater than 5" dbh and 15 to 25 feet in trees less than 5" dbh). Cut merchantable trees could be sold.	**Hand or Machine Pile** down to desired fuel loads. Hand piles should be compact, maximum 8 feet high, 6 to 8 feet in diameter, and 10 to 15 feet from live trees to minimize damage. Machine piles should be compact a minimum 20 feet from live trees, utilizing openings or clearing small openings and limited in height to minimize damage to live trees. Slash left on site - Buck tree boles 6" and greater to 6 foot lengths and lop all slash to an 18 inch slash height. **Burn Piles**	Down Fuels tons per acre ≤ 10 tons per acre. 1 to 3 tons in the < 3 inch size class and 7 to 9 tons in the > 3 inch size class.
1,2	55, 59	**Slashing**	Non	Machine	**Slash** storm damaged material (wind thrown,	**Hand or Machine Pile** down to desired	Down Fuels tons

Treatment #	Unit #	Cutting Treatment Activity	Commercial Non Commercial	Treatment Method	Hazardous Fuels Treatment Details (Harvest/Thinning)	Activity and Natural Fuels Treatment Details	Post Treatment Down Woody Fuel Load Desired Conditions
		Thinning	Commercial	Hand	uprooted, and standing trees that have broken tops, major bole damage or are leaning). **Thin** remaining live trees - Thin from below to remove ladder fuels and create a 10 foot crown spacing (approximately 20 to 30 feet bole spacing in trees greater than 5" dbh and 15 to 25 feet in trees less than 5" dbh). Cut merchantable trees could be sold.	fuel loads. Hand piles should be compact, maximum 8 feet high, 6 to 8 feet in diameter, and 10 to 15 feet from live trees to minimize damage. Machine piles should be compact a minimum 20 feet from live trees, utilizing openings or clearing small openings and limited in height to minimize damage to live trees. Slash left on site - Buck tree boles 6" and greater to 6 foot lengths and lop all slash to an 18 inch slash height. **Burn Piles**	per acre ≤ 10 tons per acre. 1 to 3 tons in the < 3 inch size class and 7 to 9 tons in the > 3 inch size class.

PROPOSED MAIN FORK AREA UNITS

Treatment #	Unit #	Activity Code	Commercial Non commercial	Treatment Method	Remarks	Fuels Treatment	Remarks
1	41	**Slashing**	Non Commercial	Machine	**Slash** storm damaged material (wind thrown, uprooted, and standing trees that have broken tops, major bole damage or are leaning).	**Machine Pile** down to desired fuel loads. Machine piles should be compact a minimum 20 feet from live trees, utilizing openings or clearing small openings and limited in height to minimize damage to live trees. Slash left on site - Buck tree boles 6" and greater to 6 foot lengths and lop all slash to an 18 inch slash height. **Burn Piles**	Down Fuels tons per acre ≤ 10 tons per acre. 1 to 3 tons in the < 3 inch size class and 7 to 9 tons in the > 3 inch size class.
1,2	42, 43,	**Slashing Thinning**	Non Commercial	Machine	**Slash** storm damaged material (wind thrown, uprooted, and standing trees that have broken tops, major bole	**Machine Pile** down to desired fuel loads. Machine piles should be compact a minimum	Down Fuels tons per acre ≤ 10 tons per

Treatment #	Unit #	Activity Code	Commercial Non commercial	Treatment Method	Remarks	Fuels Treatment	Remarks
	46, 47, 48				damage or are leaning). **Thin** remaining live trees - Thin from below to remove ladder fuels and create a 10 foot crown spacing (approximately 20 to 30 feet bole spacing in trees greater than 5" dbh and 15 to 25 feet in trees less than 5" dbh). Cut merchantable trees could be sold.	20 feet from live trees, utilizing openings or clearing small openings and limited in height to minimize damage to live trees. Slash left on site - Buck tree boles 6" and greater to 6 foot lengths and lop all slash to an 18 inch slash height. **Burn Piles**	acre. 1 to 3 tons in the < 3 inch size class and 7 to 9 tons in the > 3 inch size class.
2	44, 45	**Thinning**	Non commercial	Machine	**Thin** remaining live trees - Thin from below to remove ladder fuels and create a 10 foot crown spacing (approximately 20 to 30 feet bole spacing in trees greater than 5" dbh and 15 to 25 feet in trees less than 5" dbh). Cut merchantable trees could be sold.	**Machine Pile** down to desired fuel loads. Machine piles should be compact a minimum 20 feet from live trees, utilizing openings or clearing small openings and limited in height to minimize damage to live trees. Slash left on site - Buck tree boles 6" and greater to 6 foot lengths and lop all slash to an 18 inch slash height. **Burn Piles**	Down Fuels tons per acre ≤ 10 tons per acre. 1 to 3 tons in the < 3 inch size class and 7 to 9 tons in the > 3 inch size class.

FORESTED VEGETATION – AFFECTED ENVIRONMENT

Existing Condition

The data used for this analysis was compiled from four sources: a compartment inventory done from 1996 to early 1990's, field inventories done from 1986 to 1994, FIA summary data and professional knowledge of forest types in the area.

The 1986 to 1994 inventory was based on photo interpretation attributes of crown diameter, dominant species, height and crown closure percent. With ground reconnaissance and the use of these attributes all the stands within the treatment areas were classified into stratums, according to size, stocking, species, forest, nonforest and crown closure percent. An attached copy of the defined stratum classification is in Appendix I. Only four stands in the treatment areas have had ground sample data taken. This data is stored in the FSVEG database for the Custer National Forest.

Stratum Acreage within the Treatment Areas

Following is a table that depicts acres and percent of treatment area by stratum, see Appendix I for a definition of stratum codes. Ponderosa pine is not represented in the table below but does occur in the Benbow treatment area. In all three treatment areas in the lodgepole pine types (LP) spruce and sub alpine fir occur in the treatment polygons in small areas where water is closer to the surface or near the edge of the perennial stream banks.

TABLE: STRATUM ACRES BY TREATMENT AREA

Stratum	Acres[1]	Percent of Treatment Area
BENBOW TREATMENT AREA		
DF12	6.83	1.8%
DF14	103.96	27.6%
LP14	105.35	28.0%
LP24	49.97	13.3%
LP33	24.05	6.4%
LP34	1.83	0.5%
QA12	69.90	18.5%
00074	15.01	4.0%
Total	**376.9**	**100%**
MAIN FORK TREATMENT AREA		
00074	25.67	10.8%
00075	16.63	7.0%
DF53	6.49	2.7%
LP13	54.53	23.0%
LP23	8.49	3.6%
LP24	111.20	46.8%
SAF14	14.40	6.1%

TABLE: STRATUM ACRES BY TREATMENT AREA

Stratum	Acres[1]	Percent of Treatment Area
Total	**237.4**	**100%**

[1]These are approximate acres derived from Forest GIS coverage's.

General Forest Conditions

The major forested cover types across all three treatment areas is lodgepole pine, followed by Douglas-fir as indicated in the table below.

Approximately 95% of the Benbow treatment units are dominated by forest cover greater than 10%. Four percent is non forested or has forest cover less than 10%. Of this 95% percent the dominant species are lodgepole pine, Douglas fir and ponderosa pine. Eighteen percent is dominated by aspen.

Approximately 82% of the Main Fork treatment units are dominated by forest cover greater than 10% and 18% is non forested or has forest cover less than 10%. Of this 82% percent the dominant species are lodgepole pine, followed by spruce, sub alpine fir and Douglas-fir.

TABLE: COVER TYPE BY TREATMENT AREA

Cover Type	Percent of Treatment Area
BENBOW AREA	
Lodgepole pine	48%
Douglas fir	29%
Quaking Aspen	18%
Dry Grassland and Meadow	4%
MAIN FORK AREA	
Lodgepole pine	73%
Douglas fir	3%
Sub Alpine fir and Spruce	6%
Dry Grassland and Meadow	11%
Wet Grassland and Meadow	7%

[1]These are approximate percentages derived from Forest GIS coverage's.

Much of the lodgepole forest types on the Beartooth Face of the Beartooth district experienced a large stand replacing fire around the turn of the century and the majority of the lodgepole pine stand ages are about 100 years old. Areas across the project areas have older components as individuals or small areas that did not burn.

The national Forest Inventory and Analysis (FIA) program provides a congressionally mandated, statistically-based, continuous inventory of the forest resources (Bush, et al 2007). FIA plot data is grid base coverage and is not stand level data. The data set is

useful for characterizing forest level conditions. In the table below is summarized FIA data for the Beartooth District for the more common forest dominance types found in the treatment areas. Summarized data includes: quadratic mean diameter, total trees per acres, total basal area per acre, total board feet per acre, total age, age classes, crown cover classes and total tons per acre of downed fuels.

TABLE: FOREST INVENTORY ANALYSIS SUMMARY DATA BY FOREST DOMINANCE TYPE[1]

Dominance Type	Attribute	Estimate	90% Confidence Interval
PICO[2]			
	Quadratic Mean Diameter	6.1”	4” to 7.7”
	Total Trees per Acre	6234.1	1618.4 to 11944.9
	Total Basal Area per Acre	117.3	87.3 to 147.9
	Total Board Feet per Acre	5771	2903.7 to 8248.3
	Total Age	80.3	56.3 to 103
	Age Class 0 to 19 yrs	15.4%	0 to 28.6
	Age Class 40 to 59 yrs	21.3%	6.7 to 42.1
	Age Class 60 to 79 yrs	23.6%	9 to 46.3
	Age Class 80 to 99 yrs	12.8%	2.2 to 29.5
	Age Class 100 to 119 yrs	3.8%	0 to 14.6
	Age Class 120 to 139 yrs	6.2%	0 to 18.6
	Age Class 140 to 159 yrs	9.2%	0 to 21.1
	Age Class 180 to 199 yrs	7.7%	0 to 18.2
	Crown Cover % of Type		
	0-9% Crown Cover	12.8%	0 to 30.8
	10-24% Crown Cover	6%	0 to 15
	25-59% Crown Cover	56%	34.2 to 72.7
	60-100% Crown Cover	25.1%	11.1 to 42.5
	Fuels – Total Tons per Acre	35.6	24.3 to 48.5
PICO-PSME[3]			
	Quadratic Mean Diameter	7.2	3.9 to 10.5
	Total Trees per Acre	4677.7	2190.6 to 7164.9
	Total Basal Area per Acre	82.4	
	Total Board Feet per Acre	5264	905 to 9623
	Total Age	107	89 to 125
	Age Class 80 to 99 yrs	50%	0 to 100
	Age Class 120 to 139 yrs	50%	0 to 100
	Crown Cover % of Type		
	25-59% Crown Cover	50%	0 to 100
	60-100% Crown Cover	50%	0 to 100
	Fuels – Total Tons per Acre	37.6	35.6 to 39.5
PICO-ABLA[4]			

TABLE: FOREST INVENTORY ANALYSIS SUMMARY DATA BY FOREST DOMINANCE TYPE[1]

Dominance Type	Attribute	Estimate	90% Confidence Interval
	Quadratic Mean Diameter	4	3.7 to 4.2
	Total Trees per Acre	2762	2263.4 to 3260.7
	Total Basal Area per Acre	124.8	79.8 to 169.9
	Total Board Feet per Acre	4000	0 to 8000
	Total Age	66	45 to 87
	Age Class 40 to 59 yrs	50%	0 to 100
	Age Class 80 to 99 yrs	50%	0 to 100
	Crown Cover % of Type		
	25-59% Crown Cover	50%	0 to 100
	60-100% Crown Cover	50%	0 to 100
	Fuels – Total Tons per Acre	4.2	Insufficient data to calculate a confidence interval
PSME[5]			
	Quadratic Mean Diameter	9	6.2 to 12
	Total Trees per Acre	4101.4	1107.7 to 9091.8
	Total Basal Area per Acre	111.8	76.8 to 153.3
	Total Board Feet per Acre	5530.4	3276.4 to 7685.3
	Total Age	127	84.1 to 180.5
	Age Class 0 to 19 yrs	5.6%	0 to 20
	Age Class 20 to 39 yrs	16.7%	0 to 33.3
	Age Class 40 to 59 yrs	15.3%	0 to 33.3
	Age Class 60 to 79 yrs	6.9%	0 to 19.9
	Age Class 80 to 99 yrs	4.2%	0 to 15.4
	Age Class 100 to 119 yrs	12.5%	0 to 28.6
	Age Class 140 to 159 yrs	4.2%	0 to 16.7
	Age Class 160 to 179 yrs	4.9%	0 to 15.2
	Age Class 180 to 199 yrs	4.9%	0 to 16.7
	Age Class 200 plus	25%	3.8 to 48.6
	Crown Cover % of Type		
	0-9% Crown Cover	8.3%	0 to 23.6
	10-24% Crown Cover	4.2%	0 to 12.3
	25-59% Crown Cover	50.7%	22.5 to 71.2
	60-100% Crown Cover	36.8%	19.8 to 64
	Fuels – Total Tons per Acre	18.2	9.5 to 25
PSME-PICO[6]			
	Quadratic Mean Diameter	5.4	Insufficient data to calculate a confidence interval
	Total Trees per Acre	2612.5	Insufficient data to calculate a confidence interval
	Total Basal Area per Acre	82.4	Insufficient data to calculate a

TABLE: FOREST INVENTORY ANALYSIS SUMMARY DATA BY FOREST DOMINANCE TYPE[1]

Dominance Type	Attribute	Estimate	90% Confidence Interval
			confidence interval
	Total Board Feet per Acre	1674	Insufficient data to calculate a confidence interval
	Total Age	113	Insufficient data to calculate a confidence interval
	Age Class 100 to 119 yrs	100%	Insufficient data to calculate a confidence interval
	Crown Cover % of Type		Insufficient data to calculate a confidence interval
	25-59% Crown Cover	10%	Insufficient data to calculate a confidence interval
	Fuels – Total Tons per Acre	35.6	Insufficient data to calculate a confidence interval
PIEN[7]			
	Quadratic Mean Diameter	9.9	7.2 to 13.9
	Total Trees per Acre	2035.1	844.3 to 3587.5
	Total Basal Area per Acre	111.6	79.7 to 147.2
	Total Board Feet per Acre	6294.4	3765.3 to 9993.9
	Total Age	167.8	114 to 235.1
	Age Class 20 to 39 yrs	6.7%	0 to 18.2
	Age Class 40 to 59 yrs	6.7%	0 to 22.2
	Age Class 60 to 79 yrs	16.7%	0 to 35.7
	Age Class 80 to 99 yrs	10%	0 to 23.3
	Age Class 100 to 119 yrs	10%	0 to 23.3
	Age Class 120 to 179 yrs	8%	0 to 22.3
	Age Class 180 to 199 yrs	6.7%	0 to 16.7
	Age Class 200 plus	35.3%	13.3 to 60
	Crown Cover % of Type		
	0-9% Crown Cover	4.7%	0 to 16.9
	10-24% Crown Cover	10%	0 to 26.6
	25-59% Crown Cover	58.4%	32.7 to 77.5
	60-100% Crown Cover	26.9%	6.7 to 48
	Fuels – Total Tons per Acre	26.1	18.2 to 37
ABLA[8]			
	Quadratic Mean Diameter	4.1	2.1 to 6.4
	Total Trees per Acre	4003.8	913 to 7900.3
	Total Basal Area per Acre	93.4	32.9 to 169.1
	Total Board Feet per Acre	32131.3	414.3 to 7116.7
	Total Age	84.8	50.5 to 136.4
	Age Class 2 0 to 39 yrs	28.6%	0 to 60
	Age Class 40 to 59 yrs	10.7%	0 to 33.3

TABLE: FOREST INVENTORY ANALYSIS SUMMARY DATA BY FOREST DOMINANCE TYPE[1]

Dominance Type	Attribute	Estimate	90% Confidence Interval
	Age Class 60 to 79 yrs	25%	0 to 55.6
	Age Class 80 to 99 yrs	7.1%	0 to 28
	Age Class 120 to 139 yrs	14.3%	0 to 40
	Age Class 160 to 179 yrs	7.1%	0 to 33.3
	Age Class 200 plus	7.1%	0 to 33.3
	Crown Cover % of Type		
	0-9% Crown Cover	29.2%	0 to 60.7
	10-24% Crown Cover	29.2%	0 to 57.1
	25-59% Crown Cover	15.6%	0 to 43.6
	60-100% Crown Cover	26%	0 to54.2
	Fuels – Total Tons per Acre	35.8	13.4 to 60.4
PIEN-ABLA[9]			
	Quadratic Mean Diameter	4.1	3.5 to 4.6
	Total Trees per Acre	5417.3	1451.5 to 9383
	Total Basal Area per Acre	78.5	77 to 79.9
	Total Board Feet per Acre	1660	0 to 3320
	Total Age	97.5	44 to 151
	Age Class 40 to 59 yrs	50%	0 to 100
	Age Class 140 to 159 yrs	50%	0 to 100
	Crown Cover % of Type		
	25-59% Crown Cover	100%	Insufficient data to calculate a confidence interval
	Fuels – Total Tons per Acre	46.3	Insufficient data to calculate a confidence interval

[1]Data compiled from the Regional FIA Summary Access Data Base. [2]PICO = Pinus contorta. [2]PICO-PSME = Pinus contorta- Psuedotsuga meinziesii. [4]PICO-ABLA = Pinus contorta-Abies lasiocarpa. [4]PSME = Psuedotsuga meinziesii. [5]PSME-PICO = Psuedotsuga meinziesii – Pinus contorta. PIEN = Picea engelmannii. [8]ABLA = Abies lasiocarpa. PIEN-ABLA = Picea engelmannii - Abies lasiocarpa.

General Insect and Disease Conditions

The forested areas have endemic levels of insects and minor infections of diseases. The more common ones found in the treatment areas include: beetles (engraver, spruce, western balsam, Douglas fir and mountain pine), western gall rust (*Endocronartium harknessii*), dwarf mistletoe (*Arceuthobium americanum)* and needle cast (*Lophodermella concolor*). Physical damage is common from both snow and wind. The wind event in 2007 has had the most impact in the treatment areas.

The severe wind event in November 2007 left approximately 15,000 acres of wind damaged trees across the district. This damage is seen as individual trees to small groups or swaths of trees several acres in size of uprooted, snapped off and leaning trees. In

some areas the resulting fuel loads are in excess of 100 tons to the acre. This event has created a complex fuel depth from the ground level up to the canopy base and into the canopy.

Prominent bark beetle species found in treatment areas include: pine engraver beetle (*Ipps. pini*.), Douglas fir beetle (*dendroctonus pseudotsugae*), mountain pine beetle (*Dendroctonus ponderosae*), western balsam beetle (*Dryocoetes confuses*), and spruce beetle (*Dendroctonus rufipennis*). Mortality from these insects have been minor in the treatment areas as noted in the 2001, 2002, 2003, 2005, and 2007 aerial insect detection flights. These species are currently at endemic levels killing incidental individuals or groups of 5 to 10 trees within the project area. Increased mountain pine beetle and western balsam beetle activities occur on other areas of the Beartooth district, in particular the Picket Pin area. Beetle mortality is closely associated with overstocked, continuous stands, drought periods and secondary damaging agents such as snow or wind damage (Furniss and Carolin 1977; USDA Undated; Shepperd and Battaglis 2002).
Drought cycles have probably had the most impact on beetle activity over the past 5 years.

Pine engraver beetles are relatively non-aggressive beetles that take advantage of host material (ponderosa pine and lodgepole pine) available to adults emerging from overwintering sites. Colonizing such material in early spring often produces another generation of beetles that frequently attack and kill trees in mid-summer. Most of the pine engravers locally are *Ips pini*, but other associated species are common.

Most pine engraver (*Ips, spp*) problems are associated with disturbances such as windthrow and snow breakage, drought in spring and early summer, logging, fires, road construction, housing development or other human activities. Pine slash or weakened trees created by these disturbances attract beetles and provide ideal conditions for population buildup and subsequent tree killing.

Because pine engraver beetles overwinter as adults and normally only infest fresh slash when they emerge in the spring, activity slash created from early winter through late spring can be especially hazardous by providing large amounts of breeding material. Slash should not be created during this period unless it can be treated prior to beetle emergence.

Creating slash from about January through July increases the likelihood of subsequent tree killing. When it is not practical to avoid creating slash during high-risk months, several management practices can be used to help minimize potential impacts:

a. Prompt slash disposal. Bulldozer trampling or chipping effectively reduces the amount of breeding material by decreasing the size of logging debris and by removing and drying the bark. Burning slash also destroys potential brood sites. When burning slash, however, avoid scorching standing trees as this makes them more attractive to numerous species of bark and wood-boring insects.

b. Where slash disposal is impractical, lopping into smaller pieces and scattering it into openings is effective. Reducing the size and exposing the slash to direct sunlight dries it faster making it less suitable for beetle colonization and development.

c. When beetle populations in slash constitute a threat, creating a continuous supply of fresh slash during the flight period of emerging adults will generally attract beetles, keeping them out of standing green trees. This technique is known as providing a "green chain." New slash should be produced just as beetles enter the pupal stage. Once started, this technique should be continued for each generation that season.

An alternative to this method is the creation of very large slash piles in the spring before initial beetle flight. If piles are big enough, interior pieces will not dry before beetles from the initial generation emerge. Emerging beetles are attracted deeper into the pile, keeping them out of standing trees. Piles should be at least 20 feet wide and 10 feet deep, and distributed throughout the treated area.

d. During logging, felling trees into openings and using established skid trails to avoid damaging the residual stand are good practices to reduce pine engraver attacks on the remaining trees. Trees whose roots are exposed or disturbed and those with large patches of bark torn off should be removed.

e. An additional “control” method entails the use of pheromone-baited funnel traps to capture beetles emerging from small, infested slash piles or downed, scattered material. Traps are hung around infested piles or among infested tops, typically during the latter part of May (in Montana and northern Idaho). Emerging beetles will be attracted into traps, keeping them from infesting surrounding trees (Gibson, 2008). While more labor intensive, this method has been used successfully. Still, it should be considered secondary to proper slash treatment.

Spruce beetle outbreaks are generally short lived (4 to 5 years). Significant mortality can result (60 to 80%) in spruce stands which have a high hazard for beetle population development. Stand conditions that result in a high hazard include: average dbh of live spruce over 10” is greater than 16”, stand basal area exceeds 150 square feet per acre, canopy of spruce exceeds 65 percent, and stands on well-drained sites and drainage bottoms (Gibson, 2008).

Spruce beetles will attack recently downed trees. They have a two year cycle so assessing infestation levels in downed trees could be important in areas where the buildup of beetle populations and resulting mortality may not be desirable.

Altering stand conditions through silvicutural treatments (i.e. prescribed fire, thinning) can be an effective tool in areas where large amounts of mortality could be of consequence and adverse effects may not be desirable. Alternatives for dealing with ongoing or potential spruce beetle outbreaks include: salvage infested trees, use of trap trees baited with pheromone tree baits to lure the beetles in to selected trees or areas and then removal, pheromone-baited funnel traps emptied weekly for the period of beetle flight and no action. Use of hazard rating systems can guide management practices to

stands rated as high hazard for outbreak development or of high risk for imminent infestations.

The western balsam bark beetle is the most conspicuous of a complex of pests that are responsible for mortality in supalpine fir. This beetle is very common and often times damaging. One hundred and twenty thousand acres of sub alpine fire mortality was mapped in 2007 across Region 1, fifty five hundred acres on the Beartooth District (Gibson, 2008). The biggest contributor is the western balsam bark beetle, but likely secondary bark beetles and root pathogens exacerbated by the warmer and drier conditions the past several years are factors as well. These beetles can build up in wind damage trees and logging slash as well.

Management for infestations of western balsam beetle include: destruction of logging and windthrown slash, removal of infested trees and use of aggregative pheromones to concentrate beetles into areas scheduled for management to control populations (Kegley, 2006).

Douglas-fir beetle is the most destructive pest effecting Douglas-fir. Outbreaks are generally short lived (2-4 years) but can devastate older, larger diameter stands. Beetles are attracted to wind-throw and trees weakened by fire, drought, defoliation or root disease. Stand conditions that are most conducive to beetle outbreaks include: excess of 50 percent Douglas-fir, stands greater than 100 years (>120 years = high hazard), trees greater than 14 inches dbh, and stands greater than 150 square feet of basal area (> 250 = high hazard) populations (Kegley, 2004).

Efforts geared at prevention rather than suppression has the greatest benefits with ongoing or potential beetle infestations (Gibson, 2008). Identifying susceptible stands and altering them can help maintain mortality at acceptable levels. Stand manipulation (thinning, regeneration, salvage) that reduce stocking, percent of beetle host, average stand age, or size will produce stand conditions less favorable to Douglas-fir beetles. Removal of larger, older components can greatly reduce future mortality.

Weather-related phenomena like windthrow and snow breakage stand disturbances typically can result in the onset of a Douglas-fir beetle outbreak. Douglas-fir beetles are attracted to down trees and logs. Beetles attracted to this material can build high populations in short time periods. Generations produced from this material can attack susceptible green trees in surrounding stands. Timely salvage or down, damaged or weakened trees is the primary means of preventing outbreaks (Kegley, 2004).

Management opportunities in decreasing order of site disturbance include: salvage infested Douglas-fir, use of trap trees baited with pheromone tree baits to lure the beetles in to selected trees or areas and then removal, pheromone-baited funnel traps emptied weekly for the period of beetle flight, and no action (Kegley, 2004).

Mountain pine beetle is the most aggressive, persistent and destructive bark beetle. The most frequently attacked species that occur on the Beartooth District include: lodgepole

pine, ponderosa pine, whtiebark pine and limber pine. Outbreaks generally occur in mature to overmature forests. Large evenaged stands of lodgepole pine pose a constant hazard in areas climatically favorable for mountain pine beetle. The economic impact of beetle mortality is largely dependent on the effects of epidemics on allowable cut, regeneration of affected areas, and increased fire risk.

Tree age, size, stand structure, phloem thickness, climatic conditions and tree growth are variables that determine stand susceptibility and ultimately amount of mortality. Generally lodgepole pine 61 to 80 years and 751 to 1,500 stems per hectare have the highest risk for susceptibility to mountain pine beetle (Gibson, 2004). For ponderosa pine high risk occurs in single storied stands, mean stand diameter exceeding 10 inches, and when square feet of basal area per acre exceeds 150 in mean stand diameters of 5 inches or greater (Gibson, 2004).

Like other beetles management should focus on altering the stand conditions that predispose stands to beetle infestations. There are two strategies long term (preventative) forest management and direct control to reducing losses from mountain pine beetle.

Preventative management should be designed to increase tree/stand resistance that focuses on stands susceptibility. This is the most long term solution. Combinations of hazard ratings, priority settings, and silvicultural manipulations are the best management tools.

Effects of suppression or direct control of the beetles is only temporary. Direct control might be effective in reducing rate of spread and intensification of infestations, but is only a temporary measure until susceptible stands can be altered silviculturally. Direct control is expensive in time, effort, and resources. For suppression tactics to be successful the following should occur: early detection and control action over entire infested area within one to two years; continue control work as long as necessary; and thorough treatment and follow-up surveillance.

For high value trees in campgrounds, picnic areas, visitor centers, and around permanent and summer homes protective chemicals have been very effective. Carbaryl has been shown to be effective for up to 2 years (Gibson, 2004). Verbenone an anti-aggregative pheromone has been used but has shown less reliable results in protection (Gibson, 2004, 2008).

More recently a semiochemical has been synthesized, packaged and marketed in the form of aggregative tree bait. The intent here is to capture the natural message bearing chemical that beetles send out to mass attack individual trees. These baits are then used in various baiting strategies in combination with logging to essentially contain beetle populations in stands scheduled for harvest.

In even aged lodgepole silvicultural treatments include species conversion, stocking control, salvage and sanitation cutting. For uneven aged and mixed species lodgepole pine stocking control, clearcutting, salvage cutting, species discrimination and partial

cutting are silvicultural options for preventative and control of beetle infestations. Lodgepole is susceptible to windthrow and when partial cutting is considered a wind throw risk should be done to consider best placement of partial treatment areas.

Thinning in second growth ponderosa pine has been found to have a large impact on beetle caused mortality. Unthinned stands with 152 square feet of basal area per acre have been shown to have 8 percent of the stand killed over 5 years. In similar stands that were thinned to less than 80 square feet per acre showed 0.2 percent mortality over the same period of time (Gibson, 2004). Thinning may not be as effective if thinned next to an unthinned infested stand.

In ponderosa pine silvicultural treatments for minimizing losses includes salvaging infested trees, thinning to BA of 80 square feet per acre with continued surveillance, and salvage and thinning to maintain low stand densities (Gibson, 2004).

Western gall rust is the most common rust found in lodgepole pine and ponderosa pine. Occasional infections are found across the treatment areas. Trees of all ages are affected. Cankers on stems of seedlings and saplings are generally lethal. Stem cankers on larger trees are prone to stem breakage, especially in wind and snow events.

Management is best achieved by removal of infected or most severely infected (stem galls or more than 6 branch galls) individual trees (USDA, 2004). Thinned stands with residual branch galls tend to become inactive within ten years due to increased vigor and growth and shading out of the lower infected branches (USDA, 2004).

Dwarf mistletoes are the most widely dispersed pathogen in the western United States. Several forces influence their distribution on the landscape with fire being one of the foremost factors in their population dynamics.

Mistletoes reduce growth, wood quality, seed production ability, and life span of the host tree. The plant and the broom are important ecosystem components such as for a winter food source and nesting habitat for many wildlife species.

Management of dwarf mistletoe begins with an analysis of infection that individual trees and stands have. Hawksworth's six class dwarf mistletoe rating system is a tool that determines the relative population status of an infestation with in a stand and its potential for spread and intensification (Hoffman, 2004). This rating system simply divides the live crown into thirds and assigns a rating value of no visible infection (0), a light infection (1) or a heavy infection(3) and then adds them all up for a total tree rating. The higher the number is the larger the infection.

Silvicutural treatments that emphasize the removal or killing of infected branches or trees can reduce dwarf mistletoe impacts. Regeneration treatments have the greatest opportunity to control by removal of infested stands and replacement of mistletoe free regeneration. Precommercial thinning lightly infested stands can be beneficial but precommercial thinning heavily infested stands may not be. Generally precommercial

thinning should only be done if less than forty percent of the trees are infected and the average rating is 3 or less. Commercial thinnings should select to leave trees with dwarf mistletoe ratings of 3 or less and with infections in the lower crown. Chemical control (Florel) can be used to prevent seed production for 1 to 3 years (Hoffman, 2004). Prescribed underburning has been found to have limited reduction of dwarf mistletoe in ponderosa pine.

On the Beartooth district it is estimated that 28 percent of the lodgepole pine forest type is affected with dwarf mistletoe in 2004 (Hoffman, 2004). In the treatment areas no ponderosa pine or Douglas-fir was identified with dwarf mistletoe. Overall across the treatment areas lodgepole pine affected with dwarf mistletoe is considered light. There are individual trees and small areas that have heavy infections.

The pine needle cast (*Lophodermella conclor*) affecting the lodgepole pine in the treatment areas is a fungi that infects the current years foliage in the prior spring according to climatic conditions. Cool wet springs are conducive to infections. This one year old foliage is what turns red and is shed 13 months from infection. This foliage disease rarely causes mortality, but does cause reduction in growth.

Forest Plan Management Acreage by Treatment Area

Forest Plan management areas and their percentage of area that fall within all of the treatment units are as follows: management area B (20.8%), management area D (40.6%), management area F (30.8%) and management area T (7.8%).

TABLE: FOREST PLAN MANAGEMENT AREA BY TREATMENTA AREA

Treatment Area	Forest Plan Management Area	Acres[1]	Percent of Treatment Area
Benbow	B	128.0	34.0%
	D	248.9	66.0%
Main Fork	F	189.3	79.7%
	T	48.1	20.3%
	Total	**614.3**	

[1] These are approximate acres derived from Forest GIS coverage's.

Timber Suitability Acreage

The forested stands in the treatment areas are found on all aspects. Forested stands being defined as those forested sites where there exists 10 percent stocking or higher (or is capable of supporting). The 480.6 acres of forested lands capable of producing industrial products (tentatively suitable forested sites); by photo interpretation and ground examination are found predominately on the moist and slightly cooler, moister northerly and easterly aspects. The 76.4 acres of forested lands not capable of producing industrial products (tentatively unsuitable forested sites); by photo interpretation and ground examination are most common on the southerly, drier and slightly warmer aspects, with the exception of the aspen which occurs on wetter sites. The tentatively unsuitable acreage does include both aspen and limber pine.

TABLE: TENTATIVELY SUITABLE FORESTED ACRES BY TREATMENT AREA

Treatment Area	Acres[1]	Percent of Total Treatment Area Forested Acreage	Percent of Total Treatment Acreage
Benbow	292.0	80.7%	77.5%
Main Fork	188.6	96.7%	79.4%
Total	**480.6**		

[1] These are approximate acres derived from Forest GIS coverage's.

TABLE: TENTATIVELY UNSUITABLE FORESTED ACRES BY TREATMENT AREA

Treatment Area	Acres[1]	Percent of Total Treatment Area Forested Acreage	Percent of Total Treatment Acreage
Benbow	69.9	19.3%	18.5%
Main Fork	6.5	3.3%	2.7%
Total	**76.4**		

[1] These are approximate acres derived from Forest GIS coverage's.

DESIRED CONDITIONS

Forest Plan Management Goals and Standards

Management Area B goal is to provide for the continuation of livestock grazing, implementation of intensive range management systems and the facilitation of minerals and energy development with consideration of other resource needs. In areas not considered key for wildlife, adverse impacts to the wildlife habitat will be mitigated where feasible, but not to the exclusion of range and mineral/energy management and development activities. In key wildlife areas, the habitat may not be adversely impacted from development activities (Custer National Forest and National Grasslands Land and Resources Management Plan, 1987).

Management standards for individual resources in B include:

- Range; intensive grazing systems are preferred with the objective of improving range condition to good or better,
- Wildlife; emphasis will be to maintain existing wildlife habitats. These habitats will be improved where improvement would be consistent with other resource needs,
- Timber; forested areas will be managed to perpetuate or enhance livestock forage and wildlife habitat values. Management activities may include removal of wood products such as sawlogs, posts and fuelwood or transplant materials. Wildlife and range resources will be protected or enhanced. Silvicultural systems may include either even aged or uneven aged systems. Regeneration systems may be appropriately applied to meet management area goals. The productive forestlands within this area are classified as suitable for timber production.
- Recreation; visual quality objectives will include retention, partial retention and modification and management activities will be designed and implemented to blend with the natural landscape,

- Prescribed fire; planned ignitions may be used for range and wildlife enhancement, fuels and debris reduction.

Management Area D is to maintain or improve the long-term diversity and quality of habitat for the selected species identified by Ranger District (Beartooth – elk, bighorn sheep, black bear, moose) as well as accommodating other resource management activities such as timber harvest, livestock grazing, and oil and gas development (Custer National Forest and National Grasslands Land and Resources Management Plan, 1987).

Management standards for individual resources in the D area include;

- Recreation; visual quality objective will include retention, partial retention and modification and management activities will be designed and implemented to blend with the natural landscape.
- Wildlife; Emphasis will be placed on maintaining or improving wildlife habitats. Implementation guidelines will address: habitat and population goals for the selected species, quality and quantity of vegetation to meet habitat goals; mitigation measures to meet desired conditions; and methods to maintain or improve a diversity of habitats.
- Range; on key wildlife area range management will be aimed at mitigating adverse impacts to wildlife. Grazing systems in appropriate areas will provide for adequate residual nesting cover for sharptail grouse. Noxious weeds will be controlled.
- Timber; this management area contains lands considered suitable for timber management. Silvicultural prescriptions will identify timber treatments that will perpetuate or improve key wildlife habitat and livestock forage. Productive forest lands within this area are suitable for timber production. Silvicultural prescriptions may include either even aged or uneven aged systems. Knutson-Vandenberg funds collected from sale of forest products will first be programmed for regeneration as required by law and than other wildlife improvement treatments will be considered.
- Prescribed fire; planned ignitions may be used for range improvement and wildlife habitat, timber stand maintenance, fuels reduction, sanitation, maintaining vegetation, and associated wildlife habitat dependent on periodic fire.

Management Area F goal is to provide for a spectrum of recreation opportunities and settings in and around developed sites. Resource management should favor maintaining or enhancing the recreation opportunities including the visual setting (Custer National Forest and National Grasslands Land and Resources Management Plan, 1987).

Management standards for individual resources in the F area include;

- Recreation; visual quality objectives in the foreground viewing area will be either Retention or Partial Retention.
- Wildlife; Management activities that contribute to the opportunity of wildlife and fish related recreation are encouraged.

- Range; Livestock grazing will not be allowed in developed sites, unless it can be accommodated before or after the recreation use season and is instrumental in the management of the site.
- Timber; Harvest within developed recreation sites will normally be for removal of hazardous trees and protection of improvements. Timber within the recreation corridors is suitable for timber management as long as the goal of the management area can be met. Post, poles, fuelwood, sawlogs, and other wood products may be harvested form within developed sites providing that the recreation setting is maintained or enhanced, and the visual quality objective is achieved. Type of harvest, design of sale unit and slash treatment will be instrumental in meeting these requirements.. Harvest activities will be scheduled to minimize impacts on the recreation experience.
- Prescribed fire; Planned ignitions may be used for slash and debris disposal, enhancement of visual quality and preventive measures to reduce widlfire intensity. Unplanned ignitions will not be used as a management practice.

Management Area T goal is to provide facilities, information and interpretation to Forest visitors regarding the human and natural history of the landscape seen from the highway corridor (Custer National Forest and National Grasslands Land and Resources Management Plan, 1987).

Management standards for individual resources in the T area include;

- Recreation; the visual Quality objective for this area will be retention.
- Wildlife and Fish; winter range improvement practices for elk, mule deer and bighorn sheep will be permitted, including burning. Mechanical improvement creating surface disturbances will not be allowed.
- Timber; harvest of posts, poles, and firewood will be permitted as long as tie maintain or enhances the visual resource.
- Prescribed fire; planned ignitions may be used for debris disposal. Broadcast burning will not normally be used as a management tool.

Forest Vegetation Desired Conditions

The forest wide timberland management goal is to manage timber within sustained-yield capability to help maintain timber dependent communities, forest health, vigor, productivity, provide vegetative diversity for wildlife, eliminate tree colonization on selected wildlife grazing areas and provide scenic openings.

Vegetation management activities of timber harvesting, fuels reduction, stocking reduction and prescribed fire are tools and management activities that should be considered for the maintenance and or restoration of the structure, function and composition of forested ecosystems. Maintenance objectives include: maintain a diversity of healthy, vigorous stand structures across the landscape to enhance habitat for wildlife and forage for domestic cattle; enhance forage production for cattle and wildlife by maintaining lower canopy closures; increase the shrub, forb and grass component by opening up the canopies; maintain a mosaic of stand structures and age classes across the landscape for wildlife habitat enhancement; discourage dense timber stands so livestock

utilization patterns in transitory range will contribute to improved primary range; reduce large fire potential by improving access and maintaining stand structures that are not as susceptible to large stand replacement fire; improve transitory range throughout the managed rotation; maintain some large woody debris on the site for wildlife habitat and long term soil productivity; break up the continuity of fuels to give fire fighters safety zones and access to prevent uncontrollable wildfires from doing major resource damage and properly loss; and reduce long term susceptibility to effects of uncontrollable wildfires.

Specific Stand Conditions to Meet Fuels Objectives

The district fuels management staff identified specific fuels objectives for the project area. Desired stand conditions within the identified treatment units were designed for one or more of the following: improve access and egress in the event of wildfire, increase firefighter control effectiveness, and reduce potential effects of wildfires near important infrastructure (roads, recreation areas, recreation residences, etc.), and watersheds.

One target stand was considered to meet the focused fuel objectives. The onset of discussion by the interdisciplinary team and line management was to limit treatment to intermediate treatments with one exception. That exception was were recent wind damage created openings. Those units as identified in the treatment table will be treated as clearcuts with reserves. Individual or groups of individuals that are undamaged from the wind event will be left and these stands will be regenerated.

Desired stand conditions specific to the fuels objectives include:

Crown Spacing:	Minimum 10 x 10 feet
Bole Spacing:	≥5” dbh = 20 to 30 feet; < 5” dbh 12 to 25 feet
Fuels Tons per acre:	1 to 3 tons per acre <3” and 7 to 9 tons per acre >3”
	Total tons per acre ≤ 10 tons per acre

ENVIRONMENTAL EFFECT ON ASSIGNED ISSUES

Issue #1: Wind damage potential from effects of tree thinning.
Predictor: Risk of wind damage.
Threshold: Less than high risk.

Introduction

In November of 2007 a severe windstorm occurred across the Beartooth Ranger District, resulting in extensive wind damage in the lodgepole pine and mixed species forested stands. Reconnaissance indicated that over 15,000 acres had exhibited various levels of damage. From individual trees being uprooted, snapped off or leaning to small groups of 3-5 trees to swaths of several feet and acres in size. The issue identified above is what effect will the proposed thinning have on future wind damage.

Intermediate cutting (thinning) and creating openings (clearcutting) increases the potential for wind damage in many timber types. Lodgepole pine, spruce, and sub alpine fir is prone to wind damage due to its typical shallow root system. Ponderosa pine and Douglas fir develop a much deeper tap root (Burns and Honkala, 1990) which tends to better anchor them from wind damage effects. As the intensity of tree removal increases stands becomes more susceptible to wind damage. The predominant forest cover in the Main Fork treatment area is lodgepole pine (spruce, sub alpine fir and Douglas fir occur as smaller components) and in Benbow the major components are ponderosa pine, Douglas fir and lodgepole pine.

Assumptions, Methodology and Scientific Information

Scientific Information

A study by Schmidt and Barger in 1986 highlighted by Koch in 1996 in western Montana and south western Wyoming correlates the intensity of thinning with wind-caused damage in subsawtimber size lodgepole pine. Four types of damage were studied: leaning, uprooted, snowbent, and broken trees. This study showed residual tree damage ranged from 0.04 percent in the control study to 3.24 percent in the heaviest thinned areas (see table below). The average diameter ranged from 2.7 to 4.8 inches with snowbent and broken tree damage highest in the smaller diameter. Uprooting damage was highest in the larger diameter trees due to the shallow lateral root support in pole size and larger lodgepole pine (Schmidt and Barger, 1986). Hurricane force winds are uncommon over the range of lodgepole pine in North America (Koch, 1996) and this study did not assess those uncommon events as the Beartooth District experienced in the fall of 2007.

TABLE: PERCENT OF RESIDUAL STEMS DAMAGED BY THINNING INTENSITY

Thinning Intensity	Leaning	Uprooted	Snowbent	Broken	Total Damage
Control (unthinned)	<0.01%	<0.01%	0.02%	0.02%	0.04%
33 percent basal area removal	0.24%	0.29%	0.06%	0.36%	0.55%
66 percent basal area removal	0.87%	1.34%	0.48%	0.55%	3.24%

Schmidt and Barger's 1986 study concluded that intermediate cutting (thinning) does not equate to excessive wind damage. Relatively little damage was observed and the largest amount of damage was observed where intermediate cuttings were subjected to winds sweeping across adjacent clearcuts. They further concluded that intensity of cutting had a positive influence on wind damage. And to minimize wind damage in intermediate cuttings adjacent to clearcuts, exposure to winds should be minimized by positioning intermediate cuttings upwind of clearcuts or limiting angle of exposure of stand edges to expected wind direction to less than 45 degrees.

Koch (Koch, 1996) recommends clearcutting rather than partial cutting for mature lodgepole pine forests of fire origin because of excessive mortality form windthrow as they contain a large component of low vigor trees. To minimize wind damage from created openings Koch (1996, pg 271) has recommended sizing and locating of cutting

boundaries to minimize wind damage around the perimeter of openings. Protection from wind for the vulnerable leeward boundary is most important. Other criteria for consideration by Koch include:

- Minimize cutting unit boundary by making cutting units as large as conditions permit.
- In higher elevations, do not locate cutting boundaries where they are exposed to wind funneling through saddles and ridges.
- Avoid cutting boundaries on ridges or near saddles in ridges, especially ridgetops of secondary drainages to the lee and at right angles to the main drainage when the latter is a narrowing valley with steep slopes.
- Maximize cutting boundaries parallel to the contour or along a road where topography, soils, and stand conditions will permit.
- Do not lay out cutting units with wind-catching indentations (that can funnel wind into reserved stands) or with long straight lines and square corners in the leeward (downward) boundary or in boundaries that are parallel to storm winds.
- Do not locate cutting boundaries on poorly drained or shallow soils: trees on such soils are susceptible to windthrow.
- Locate cutting boundaries in stands of sound trees, and preferably in immature stands, as young trees in immature stands are not easily uprooted.
- Locate boundaries in poorly stocked stands, as opengrown trees are more windfirm than trees grown in dense stands.
- Avoid locating cutting boundaries in areas where there is evidence of old wind damage.
- Reduce blowdown in areas with exceptionally hazardous windthrow situations, by locating the vulnerable leeward boundaries where hazards are below average, or by eliminating such boundaries by progressive cutting into the wind: such progressive cutting presents a tapered edge with short young trees backed up by progressively taller trees downwind of the clearcut.

Alexander (1986) recommends the guidelines above for minimizing wind damage around spruce openings as well. Alexander has further identified wind damage based on topographic exposure as defined in table below.

TABLE: WINDFALL RISK VS. EXPOSURE

Windfall Risk	Exposure	Topographic Position
Below Average	Low	1. Valley bottoms, except where parallel to the direction of prevailing winds, and flat areas. 2. All lower, and gentle middle north- and east- facing slopes. 3. All lower, and gentle middle south- and west- facing slopes that are protected from the wind by considerably higher ground not far to windward.
Above Average	Moderate	1. Valley bottoms parallel to the direction of prevailing winds. 2. Gentle middle south and west slopes not protected to windward.

		3. Moderate to steep middle, and all upper north and east-facing slopes. 4. Moderate to steep middle south- and west-facing slopes protected by considerably higher ground not far to windward.
Very High	High	1. Ridgetops. 2. Saddles in ridges. 3. Moderate to steep middle south- and west-facing slopes not protected to windward. 4. All upper south- and west-facing slopes.

Assumptions and Methodology for Risk Rating Treatments for Wind Damage
For the project area a potential wind damage assessment was done on each treatment unit and then an overall treatment area risk rating assigned (Sandbak, 2008). Four attributes were evaluated: species susceptibility based on rooting habit, intensity of cutting treatments, clearcutting (including aspen opening within conifer stands), and topographic exposure.

A relative rating of low, moderate and high risk was used with a value assigned of 1, 2 or 3 respectively. For rooting habit those species with shallow lateral roots (lodgepole pine, spruce, sub alpine fir) were assigned a high rating while those with a tap root system or deeper lateral system (ponderosa pine, Douglas-fir) were assigned a low rating. The predominant forest strata species label for each treatment unit was used for the assessment.

For intensity of treatments of thinning, salvage, and liberation a low rating was assigned. The assumption here is that these proposed treatments will not remove more than 66 % of the basal area and as the Schmidt and Barger study in 1987 indicated for this thinning intensity the average wind damage across their study was less than 4% of the residual stand.

Clearcutting and aspen opening within conifer stands were assessed a low or moderate rating. Assumptions for this include: Koch guidelines for sizing and locating of cutting boundaries will be considered in layout where possible to minimize wind damage, past openings in West Fork show limited wind damage along perimeter and that most of the clearcuts or openings will be small but will occur in lodgepole pine types which is more susceptible to wind damage. Openings in the lodgepole types were assessed a moderate rating. The largest openings will be in the Benbow area in Dougls-fir types less susceptible to wind damage which was assigned a low rating.

Alexander's (1987) exposure rating was used to assess risk based on topographic position and prevailing winds. When considering topographic position alone the risk would be low for all treatment areas. However, when considering prevailing winds that parallel the drainage bottom like that in West Fork and Main Fork the rating becomes moderate.

Environmental Consequences

Using the above methodology and assumptions the range of risk for treatment units by treatment area and the overall treatment area risk to wind damage is displayed in the tables below. For the no action openings created by the 2007 wind event where risked as a clearcut.

TABLE: WIND DAMAGE RISK FOR NO ACTION ACROSS TREATMENT AREAS

Treatment Area	Individual Treatment Units Range of Risk[1]	Overall Treatment Area Risk[1]
Benbow	.95 to 1.33 (low to highlow)	.95 (lowlow)
Main Fork	1.67 (highlow)	1.67 (highlow)

1LowLow = 0 to 1.0; Low = 1.0 to 1.33, ModerateLow = 1.34 to 1.66; HighLow = 1.67 to 1.99; LowModerate = 2.0 to 2.33, Moderate = 2.33 to 2.66, HighModerate = 2.67 to 2.99; High = 3.0.

TABLE: WIND DAMAGE RISK FOR PROPOSED ACTION ACROSS TREATMENT AREAS

Treatment Area	Individual Treatment Units Range of Risk[1]	Overall Treatment Area Risk[1]
Benbow	1 to 1.67 (low to highlow)	1.27 (low)
Main Fork	2.0 (lowmoderate)	2.0 (lowmoderate)

1LowLow = 0 to 1.0; Low = 1.0 to 1.33, ModerateLow = 1.34 to 1.66; HighLow = 1.67 to 1.99; LowModerate = 2.0 to 2.33, Moderate = 2.33 to 2.66, HighModerate = 2.67 to 2.99; High = 3.0.

Direct, Indirect, Cumulative Effects of No Action Alternative for Issue #1

Wind damage is a natural process and will continue across the treatment area landscapes. As Schmidt and Barger found wind damage (leaning, uproot, snowbent, and broken trees) occurred at very small levels (.04%) across their study stands with no treatment. Small scale wind damage will continue with areas having concentrated damage due to strong frontal passages and high impact storm events (i.e. thunderstorms). Wind events like that of 2007 on the Beartooth District are not common, but can happen in the future. Occurrence of that type of event would likely see similar wind damage. The overall effects of the no action alternative (not including 2007 type events) are that the treatment areas landscapes will likely remain in a lowlow to a highlow risk. Under the no action alternative, no fuels treatments would occur. Past management in the treatment units has been very limited; therefore cumulative wind damage effects are anticipated to be minimal. Reasonable future activities include limited post and pole activities and firewood cutting resulting in minimal cumulative effects.

Direct, Indirect, Cumulative Effects of Proposed Action for Issue #1

When considering species susceptibility, treatment intensity, creation of openings, topographic position and the prevailing winds the direct effects of the proposed treatments will increase the risk for wind damage. The direct effects are removal of trees which indirectly changes the surrounding area around trees that make them more susceptible to wind damage. The majority of the treatment acres are a thinning from below prescription. Under this treatment the remaining trees are generally the more vigorous individuals, which are less likely to have snowbent, and leaning tree damage.

Post treatment, the Benbow treatment area will be in a low risk for wind damage largely due to the dominance of windfirm species, the topographic position and the treatment units not being in the drainage bottoms that parallel the prevailing winds.

The overall wind damage risk for Main Fork after treatment is lowmoderate mainly due to the major species susceptibility to wind damage and the fact that the treatment units lie in or slightly above the drainage that parallels the prevailing winds.

As identified in the tables above there is a slight increase (one risk level increase) for wind damage as a result of proposed action implementation. There will be a slight increase in wind damage from proposed treatments, over past, present and future activities.

Summary of Consequences of Alternatives for Issue #1
Wind and resultant tree damage is a natural function of these ecosystems that will continue in the project areas. Major wind events and resultant widespread wind damage like that of 2007 are rare but could happen in the future whether the proposed action or no action is implemented. Implementation of the proposed action will increase potential of wind damage. Benbow's no action risk is lowlow and elevates to a low under the proposed action. For Main Fork it goes from a highlow to a moderatelow. These are a slight increases and below the threshold of high.

Issue #2: Bark beetle potential in areas of wind damaged trees.
Predictor: Increased levels over the next 2 years.
Threshold: Less than epidemic levels.

Introduction
The November 2007 wind storm caused widespread damage in the lodgepole pine and mixed forest types across several thousand acres (~15,000 acres). The resultant damage was uprooting, partial uprooting, and wind snapped (broken stems a few feet to several feet off the ground) trees. In some stands scattered individuals are damaged with some 3 to 5 tree clusters. Other areas these clusters occur over large expanses. And in other areas wide swaths of several acres have few standing trees remaining. These kinds of events create available material for a host of beetles to infest. Recent mortality is likely to be infested with beetles. Dependent on weather, vigor of trees and population levels beetles could infest live trees.

The amount and expanse of this wind damage has caused concern of what it may do to elevate beetle infestations and potentially increasing mortality which further ads to the hazardous fuel loads.

Assumptions, Methodology and Scientific Information
On May 20 and 22 of 2008 Ken Gibson, Entomologist from the Forest Health Protection Missoula Field Office visited the area to assist in assessing bark beetle potential.

Portions of Main Fork Rock Creek, Benbow and West Fork Rock Creek treatment areas were visited.

In the Main Fork most of the downed trees observed were lodgepole pine with small pockets of large diameter Engelmann spruce. There were no bark beetles found infesting down trees at that time. Gibson indicated that there is a high potential for pine engraver beetle (*Ipps pini*) to infest the lodgepole pine and spruce beetle (*Dendroctonus rufipennis*) to infest the spruce.

There were no spruce beetle-killed trees observed during the 2007 aerial insect detection flights (Gibson, 2008). However, it is reasonable to assume that endemic populations occur. Spruce beetles have a two year cycle with adults flying in early summer. Once the beetles fly, the district will need to assess how much of the downed spruce may be infested to determine population levels and urgency of treating downed trees infested prior to beetle emergence in spring of 2010. It is reasonable to assume there will be insipient populations concentrating in some of the numerous windthrown spruce trees (Gibson, 2008).

In the Benbow area lodgepole pine, ponderosa pine, Douglas-fir and Engelmann spruce occur. There were no down trees infested with beetles, but the potential seems quite high (Gibson, 2008). Unlike the spruce beetle, the 2007 aerial insect and disease flight detected small groups of Douglas-fir beetle killed trees. The potential for the downed Douglas-fir being infested is high. Outbreak potential within the next few years will be largely dependent on weather. Again, assessment after beetle flight will aid in predicting population buildups.

On the adjacent forest service lands near 4K ranch a few new attacks by the engraver beetle in downed ponderosa pine and Douglas-fir beetle in the downed Douglas-fir were observed. Attacks are just starting and anticipated to increase. Mountain pine beetle was also found in the lodgepole and ponderosa pine. These attacks represent endemic populations; however with the extensive lodgepole pine stands on the District and the documented high mountain pine beetle populations across the region (more than 891,000 acres in 2007) the potential must be recognized. The potential for mountain pine beetle populations to increase due to the wind damaged trees is low. This is because mountain pine beetles rarely attack downed trees.

In the West Fork treatment areas the Senia summer home area, Cascade Campground, Basin Campground and Wild Bill Lake area were assessed for beetle potential. The Pine Grove Campground and Palisades Campground were also assessed.

The forest types in the Senia summer home area and the Basin Campground are a combination of lodgepole pine, Engelmann spruce and sub alpine fir. The wind damaged trees had no insect activity observed. No beetle activity was detected in the predominately lodgepole pine in the Basin Creek Campground and Wild Bill Lake area.

In the lodgepole pine dominated Pine Grove Campground several trees with pine engravers, a few trees with red turpentine beetles, and one tree with a secondary beetle (*D. valens LeConte*) were observed. Secondary beetles mainly infest recently dead, dying or downed trees and are economically unimportant. Red turpentine beetle is generally not a tree killer and seldom are outbreaks extensive or severe (Bell Randall, 2006).

Outbreaks of pine engraver beetles in lodgepole pine in the treatment areas are low for several reasons. First engraver beetle outbreaks in lodgepole pine are unusual. Second, the relatively cool wet conditions this spring is not conducive to beetle activity. Third, the numerous trees with some root contact should provide brood sites for the mid-summer generation of beetles. Fourth, most of the wind damage in the lodgepole pine is lower risk for activity for engraver beetle as these elevations are typically not favored by the beetle (Koch, 1996).

Palisades Campground, which is outside any of the treatment areas, contains lodgepole pine, Engelmann spruce and ponderosa pine. The area had minor amounts of storm damage. There was one tree observed each of ponderosa pine and lodge pole pine that had been attacked by mountain pine beetle in 2007. This is an endemic population but their presence indicates now may be the appropriate time to consider hazard-reducing measures to reduce the risk of a population increase. Within the campground carbaryl could be used to protect individual trees. Additional thinning within the campground should reduce both fire hazard and threats from mountain pine beetle to both lodgepole and ponderosa pine. Pine engraver was noted in some of the recent slash from thinning activities. Adhering to appropriate slash treatment guidelines should reduce potential.

Management can focus on altering stand conditions that predispose stands to beetle infestations. There are two strategies long term (preventative) forest management and direct control (suppression) to reduce losses from beetle (Gibson, 2004).

Preventative management should be designed to increase tree/stand resistance that focuses on stands susceptibility. This is the most long term solution. Combinations of hazard ratings, priority settings, and silvicultural manipulations are the best management tools. The proposed action is a preventative management strategy and is designed to reduce stems per acre in the treatment units, which should reduce the tree/stand susceptibility.

Effects of suppression or direct control of the beetle populations is only temporary. Direct control might be effective in reducing rate of spread and intensification of infestations, but is only a temporary measure until susceptible stands can be altered silviculturally. Direct control is expensive in time, effort, and resources. For suppression tactics to be successful the following should occur: early detection and control action over entire infested area within one to two years; continue control work as long as necessary; and thorough treatment and follow-up surveillance.

Direct, and Indirect, Effects of Proposed Action and No Action for Issue #2

The direct effect of the wind event in 2007 was killed and damaged trees that provided material for a host of beetles to infest. Beetles may attack the dead trees and if populations build some beetles may move into the live trees.

Beetles are a component and function of the forested ecosystem. Insects are one of the primary recycling agents in forested stands. It is recognized that both endemic and epidemic types of activities are characteristic of the forests in which most of our native tree species evolved. Insect activities are important mechanisms by which native biodiversity is maintained. Insect influences on succession are among the most important function in forests ecosystem. (Hagle et al, 2000). They can also indirectly provide important wildlife habitat (snags, down woody material).

However, when populations increase to epidemic levels that could result in widespread levels of mortality balancing the needs of social concerns should be conciderecd. In areas where development has occurred (designated campground and infrastructure facilities) or areas where the forest plan has designated them within the suitable timber base a do-nothing approach may not be a viable option. The proposed treatment areas fall in both of these categories.

As far as aesthetics are concerned, infestations may have little impact on the viewer. However, dead trees can have an enormous impact on areas relative to recreation, wildlife, build up of fuel, fire hazard and plant succession.

Douglas-fir and spruce beetles have the greatest threat of outbreaks within the windthrown stands across the treatment area. The outbreak potential for engraver beetles is low. Only in times of unusually warm and dry weather do outbreaks of engraver beetle in lodgepole pine occur (Gibson, 2008). The outbreak potential for engraver beetles in ponderosa pine does not appear to be extreme. Engraver beetles can be easily managed in treated areas through proper slash treatment.

The threat of a mountain pine beetle outbreak in the windthrown trees is low as rarely do mountain pine beetles infest downed trees.

Many areas of wind damaged trees will not be treated under this proposal and the proposed treatment units may not be treated till winter of 2008 or later. Life cycles (1 to 2 years) of individual beetles, weather during those life cycles and acceptable hosts are largely the determining factor whether there will be an population outbreak or not. Therefore, it will be essential to monitor beetle populations into 2009. Cool, wet weather will reduce outbreak potential, while warmer, dryer than normal conditions will increase potential.

In a more broad level assessment the potential for a widespread infestation of Douglas-fir, mountain pine and spruce beetles on the Beartooth District is low. Using FIA data the percent of the district rated as a high risk for Douglas-fir beetle and for mountain pine beetle is both low at about 2%. Spruce beetle is slightly higher at about 4%.

TABLE: DOUGLAS-FIR BEETLE HAZARD ON THE BEARTOOTH DISTRICT

Risk value	Percent of District	90% Confidence Interval
None	76.6	66 – 85.7
High	2.1	0 – 4.9
Low	11.1	5 – 18.8
Moderate	10.2	4.4 – 17.3

TABLE: MOUNTAIN PINE BEETLE (LODGEPOLE PINE) HAZARD ON THE BEARTOOTH DISTRICT

Risk value	Percent of District	90% Confidence Interval
None	70.6	61 – 79.5
High	2.1	0 – 5.3
Low	14	7.7 – 20.9
Moderate	13.2	7.4 – 19.2

TABLE: SPRUCE BEETLE HAZARD ON THE BEARTOOTH DISTRICT

Risk value	Percent of District	90% Confidence Interval
None	67.7	57.8 – 76.8
High	4.3	1.1 – 8.4
Low	20	13.5 – 27.5
Moderate	8.1	3.3 – 13.5

Summary

Potential beetle population increases vary by species as an indirect effect of the wind event. Weather conditions into 2010 are likely the main factor that will determine which direction the population will go. If weather conditions stay cool and wetter, under both the no action and the proposed action it can be expected that endemic populations will persist in the wind damaged trees over the next few years with continued activity across the treatment area in live trees as seen over the past years. If weather conditions are warmer and dryer, under the no action alternative populations of the Douglas-fir beetle and the spruce beetle have the highest potential to move into live trees and potentially create high mortality. The proposed action if implemented would reduce that potential in the treatment units for two reasons. First, removal of infested downed trees (large slash and cull material) removes the potential brood sites for the beetle. Second, the proposed thinning and regeneration harvests will change stand conditions (stocking density) not conducive to beetle infestations. Stand alterations to reduce susceptibility are well documented by each beetle as discussed earlier.

Gibson noted that it is advantageous to monitor latter this year to better access the population status. That monitoring may dictate changes in suppression strategies and prevention strategies. It must also be recognized that the proposed treatment is treating a small percentage of the wind damaged area and if populations build the proposed treatment may have little effect on those untreated areas.

Determination whether the threshold (epidemic population levels) will be met cannot be fully determined at this time without further assessment and what the general weather pattern will be.

Issue #3: Effects of post treatment regeneration on fire potential.
Predictor: Potential Fire Type – surface, passive crown, active crown or running crown.
Threshold: Less than active crown.

Introduction
A concern has been addressed that post treatment regeneration as a result of implementation of the proposed action may attribute to fuel loading and increased fire potential. The majority of the proposed silviculture systems are intermediate and not regeneration treatments. Approximately 66 acres (11 %) are regeneration treatments and 548 acres (89%) are intermediate treatments. The Main Fork drainage has no regeneration treatments proposed. Benbow has 2 regeneration openings proposed as a direct result of the November 2007 wind event, one at approximately 46 acres and one at 20 acres.

The intermediate treatments are not designed for regeneration establishment; to meet the fuel objectives single story structures are desired. However, it is realized that the tolerant species (Douglas-fir, Engelmann Spruce and sup alpine fir) will continue to establish under these canopies (creating ladder fuels). Establishment of understories is dependent on many things, weather, species, seed availability, adequate seed bed, moisture, etc.. It is also realized that future treatment of new understory is likely. Timing of treatment will depend on when this undersory becomes a risk for fire moving into the crowns. These units are expected to be managed as single story conditions into the future until another decision is made.

The issue being regeneration, this analysis is focused on proposed treatments where the desired condition is reestablishment of a new stand and the effect this conifer tree regeneration has on potential fire type.

Assumptions, Methodology and Scientific Information
The Forest Vegetation Simulator using the Fire and Fuels Extension (FFE-FVS) was utilized to model potential fire (surface, passive, active or crown). The Forest Vegetation Simulator portion is a growth model and simulates the growth of a stand overtime. The fire and fuels extension uses the various simulated stand structure and conditions to assess potential fire. FFE-FVS models within individual stands and does not model landscape potential fire using stand conditions from adjacent stands.

Crown fires are typically faster moving than surface fires, more difficult to suppress and result in more tree mortality. FFE-FVS uses stand level data (surface fuel and stand structure) to predict whether a fire is likely to crown. The model calculates and uses two indices to predict crown fire hazard. The torching index is the 20 foot wind speed where a surface fire is expected to ignite the crown layer. The crowning index is the 20 foot wind speed needed to support an active or running crown fire. Torching index depends

on surface fuels, surface fuel moisture, height to the canopy base, slope steepness, and wind reduction in the canopy. As surface fire intensity increases (with increasing fuel loads, drier fuels, or steeper slopes) or canopy base height decreases, it takes less wind to cause surface fire to become a crown fire. Crowning index depends on how dense the canopy is, slope steepness, and surface fuel moisture content. As stands becomes denser, active crowning occurs at lower wind speeds, and the stand is more vulnerable to crown fire. Lover index numbers indicates crown fires can be expected to occur at lower wind speeds. Drier conditions produce lower indices, thus a more severe risk of crown fire.

FFE-FVS models four types of fire surface fire, passive crown fire, active crown fire, and running crown fire under both severe and moderate fire conditions. These fires are characterized in increasing severity as:

Surface fire (S) – crowns do not burn, fire stays on the ground surface.

Passive crown fire (P) – some crowns will burn as individual trees or groups of trees torch.

Active crown fire (A) – the fire moves through the tree crowns, burning all crowns in the stand (thus killing all trees).

Running crown fire (C) - the fire move rapidly through the tree crowns, burning all crowns in the stand (thus killing all trees).

Two lodgepole pine stands (2080200020 and 2080300008) were selected in the West Fork drainage to demonstrate the effect post seedling establishment has on potential fire type.

Stand 2080200020 has 2,836 total trees per acre with a quadratic mean diameter of 2.9 inches. The habitat type is a 650 (sub alpine fir/bluejoint - wet) (Pfister et al, 1977), on a north aspect with an average slope of 4%. The overstory is dominated by lodgepole pine and spruce and limited sub alpine fir. The understory is dominated by heavy alpine fire and Engelmann spruce. This stand is generally characterized as a lodgepole sawtimber stand (>9 inches) and a crown cover greater than 70%.

Stand 2080300008 has 1,422 total trees per acre with a quadratic mean diameter of 3.4 inches. The habitat type is a 730 (sub alpine fir/grouse whortleberry - cool and moderately dry) (Pfister et al, 1977) on a northeast aspect with an average slope of 8%. The overstory is dominated with lodgepole pine. The understory is dominated by limber pine and sub alpine fire. This stand is generally characterized as a lodgepole pole timber stand (<9 inches) and a crown cover greater than 70%.

Three scenarios were modeled (no action, proposed action with no thinning, and proposed action with thinning) for both stands to compare the potential fire type between the no action and the proposed action alternative. For comparison purposes a wildfire was modeled in 2026 for all scenarios. This date was selected for two reasons. The first is to be able to compare post thinning effects of the regeneration in the proposed action on potential fire. The second was largely due to Coles and Koch's (Cole and Koch, 1995) recommendation of waiting till age 16 in lodgepole pine to thin on spacing's wider than 10 feet to minimize ingrowth in the stand.

The no action run was modeled with only the simulated fire in 2026. The proposed action simulation harvested all trees in 2009 (simulating the regeneration harvests), maintained the desired down woody fuel loadings (<10 tons/acre in the 1 inch plus category) invoked natural regeneration and then a simulated a fire in 2026. The second simulation of the proposed action modeled the same but added thinning at age 16.

Simulated fire parameters for both severe and moderate conditions were constant across all scenarios. For severe fire conditions twenty foot wind speeds equaled 20 mph, temperature 70 degrees fahrenheit, 100% of stand burned, season of fire was after green up/before fall and moisture level used was very dry (1 hour fuels = 4%, 10 hour fuels = 4%, 100 hour fuels = 5%, 1000 hour fuels = 10%, duff = 15% and live fuels = 70%). For moderate fire conditions twenty foot wind speeds equaled 6 mph, temperature 70 degrees fahrenheit, 100% of stand burned, season of fire was after green up/before fall and moisture level used was very dry (1 hour fuels = 12%, 10 hour fuels = 12%, 100 hour fuels = 14%, 1000 hour fuels = 25%, duff = 125% and live fuels = 150%).

Thinning from below to 302 trees per acre (12' x12' spacing) was modeled at age 16 for the proposed action thinning scenario, with assumed hand piling of activity slash followed by burning of piles.

Direct, and Indirect, Effects of No Action and Proposed Action for Issue #3

The predictions of potential fire are all under the assumptions stated above and modeled for within stand conditons. Stand conditions in both pre and post treatment conditions are all subject to high levels of mortality in very extreme fire conditions. Especially high winds and fire generated preheating/drying winds. By treating stands to lower densities, remove ladder fuels and decrease canopy densities the risk of stand replacement mortality is lowered.

For stand 2080300008 up to year 2019 under all three scenarios for both severe and moderate conditions the potential is a surface fire (see table below). Under the no action, a running crown fire is predicted from year 2019 up to the simulated fire in 2026. Largely due to stand structure of high stem density, continuo's ladder of fuels to crown and dense compact canopies.

For the proposed action (both thinned and not thinned) under moderate fire conditions a surface fire is predicted across the span of years. Under severe conditons a surface fire is predicted up to year 2019. A passive fire is predicted to the year of the simulated fire in 2026 resulting in individual or groups of trees torching out whether thinning at age 16 occurs or not. Young lodgepole pine canopy and stem diameter expand rather rapidly, providing there is available growing space and light and water are not limited. In this juvenile age (10 to 30 years) height to canopy is generally short and with a dense compact continuous canopy. Thinning tends to increase diameter and canopy growth. For these reasons passive fires are predicted under severe fire conditions in year 2019 to 2026.

The simulated fire in 2026 across all scenarios killed the entire stand of trees. Lodgepole pine has a very thin bark and is highly susceptible to fire damage and is likely the reason for the high mortality. The fire potential post fire then returns to surface.

TABLE: POTENTIAL FIRE BY YEAR AND FIRE TYPE FOR STAND 2080300008

Year	No Action		Proposed Action - No Thin		Proposed Action - Thin	
	Severe	Moderate	Severe	Moderate	Severe	Moderate
2009	S	S	S	S	S	S
2014	S	S	S	S	S	S
2019	C	S	P	S	P	S
2024	C	S	P	S	P	S
2026 – Year of simulated fire under all scenarios 99 to 100% trees killed.						
2029	S	S	S	S	S	S

Stand 2080200020 has about 1,400 more trees per acre and under the no action alternative this increase in tree numbers results in predicted fire as an active crown fire from the onset of the simulation. For moderate fire conditions surface fire is predicted. See table below.

For the proposed action with or without thinning at age 16 surface fires are predicted for both severe and moderate fire conditions. The difference from passive fire in 2019 and beyond in stand 2080300008 to surface fire in 2080200020 has to due with site conditions of the stands. Stand 2080200020 occurs on a wetter site with a grass dominated understory component that limits regeneration. The model simulated about 170 trees per acre less regeneration. This lower tree per acre created enough of a change in stand structure conditions (lower trees per acre, less compact canopy) that are less conducive to torching of trees.

Again, as with stand 2080300008 the simulate fire killed all trees in 2026. As expected the fire potential post fire returns to surface.

TABLE: POTENTIAL FIRE BY YEAR AND FIRE TYPE FOR STAND 2080200020

Year	No Action		Proposed Action - No Thin		Proposed Action - Thin	
	Severe	Moderate	Severe	Moderate	Severe	Moderate
2009	A	S	S	S	S	S
2014	A	S	S	S	S	S
2019	A	S	S	S	S	S
2024	A	S	S	S	S	S
2026 – Year of simulated fire under all scenarios 99 to 100% trees killed.						
2029	S	S	S	S	S	S

Summary
The simulated runs for the no action alternative predicted both an active crown fire and a running crown fire under severe conditions and a surface fire under moderate conditions. For the proposed action whether thinning occurred or not at age 16 the predicted potential fire did not change. What did change between the two simulated runs for the proposed action was the cool moderately dry site tended to grow more trees per acre and a passive fire was predicted by year 2019. The simulated fire (under very dry conditons) in year 2026 killed all trees under all scenarios.

What this analysis did demonstrate using the FFS-FVS model was that under moderate fire conditions potential fire type did not change whether the no action alternative or the proposed action of regenerating a new crop of trees was implemented they remained a surface fire. That is no change in fire potential under stated assumptions. More importantly what the simulation showed was implementing the proposed action (promoting regeneration) vs. maintain the existing stand conditons (no action) on the two selected stands lowered the severity and the predicted potential of mortality under severe fire conditions. The no action alternative exceeded the threshold of active crown fire in all but the first five years in stand 2080300008 under severe fire conditions. For moderate conditions the no action stayed below the threshold of active crown fires. The proposed action promoting regeneration stayed below the threshold in both stands for both severe and moderate fire conditions.

It must be recognized this analysis was for the first 17 years after implementation. Without some stocking control in the regeneration treatments overtime the stands would likely develop into existing conditions we have today.

Cumulative Effects
Cumulative effects analysis area is the sub compartments that the treatment units fall in. Past, present and reasonably foreseeable activities that were considered include:

Past Activities
Past activities in the project area have included intensive grazing management systems for domestic cattle, aggressive wildland fire suppression, incidental personal use fire wood cutting, recreational hunting for big game, past logging, fuels treatment and post sale and timber stand improvement activities.

Harvest, fuels treatment and wildfire acres that have been documented in the Forest Service Activity Tracking System (FACTS) and considered in the cumulative effects include:

TABLE: PAST ACTIVITIES AND ACRES BY TREATEMENT AREA

Treatment Area	Activity	1979	1980 - 1989	1990 - 1999	2000 - 2007	Total
Benbow	Regeneration Harvest	25	80	22	4	**131**

TABLE: PAST ACTIVITIES AND ACRES BY TREATEMENT AREA

Treatment Area	Activity	1979	1980 - 1989	1990 - 1999	2000 - 2007	Total
	Intermediate Harvest	0	8	0	10	**18**
	Wildfire – High Intensity	162	0	2	0	**164**
	Wildfire – Low Intensity	0	2	2	0	**4**
	Fuels Treatment – Natural and Activity					
	Broadcast Burn	0	49	0	0	**49**
	Jackpot Burn	0	0	2	0	**2**
	Dozer Piling	0	10	0	0	**10**
	Burn Dozer Piles	0	23	0	0	**23**
	Lop and Scatter	0	12	18	2	**32**
	Ecosystem Burn	0	0	12	0	**12**
	Totals	**187**	**184**	**58**	**16**	**445**
Main Fork	Intermediate Harvest	0	1	36	17	54
	Wildfire – High Intensity	0	136	0	0	136
	Wildfire – Low Intensity	0	1	140	3	144
	Fuels Treatment – Natural and Activity					
	Lop and Scatter	0	0	1	0	1
	Prescribed Burn – Shrub/Grassland	0	0	69	0	69
	Prescribed Burn – Wildlife	0	0	69	0	69
	Totals	**0**	**138**	**315**	**20**	**473**
	Grant Total	**187**	**322**	**373**	**36**	**918**

[1]Activities are only included that fall within the subcompartments that the treatment units fall within.
[2] These are approximate acres derived from Forest GIS coverage's.

These activities have been grouped together by category, individual FACTS Id's by year of treatment and acres can be found in the project record.

Present Activities
Present activities in the project area are similar to past activities, with the exception of no commercial logging and include intensive grazing management systems for domestic cattle, aggressive wildland fire suppression, limited personal use firewood and post and pole cutting and seasonal recreational hunting for big.

Reasonably Foreseeable Future Activities
No activities except those described above under present activities, are planned to occur in this project area unless the proposed action activities in this analysis are implemented.

Summary of Cumulative Effects
Past, present and reasonably future activities have contributed to an increased homogeneity of the landscape vegetation and fuels mosaic. These homogeneous

conditions (dense stands, continuous ladder fuels and full canopied stands) put landscapes at a higher risk for large stand replacement disturbances and downward trends in forest health and sustainability.

The biggest cumulative effect from these treatments will be on the potential to alter fire behavior during a wild fire event. Fire behavior is strongly influenced by stand and fuel structure (tree density, ladder fuels, surface fuels and crown canopy). Crown fires are dependent on the sequence of available fuels starting from the ground surface to the canopy. Limiting crown fire in the project area can be accomplished by the proposed individual treatments cumulatively through treatments of surface, ladder and crown fuels across this landscape. The proposed action can help produce diverse forest structures and fuels characteristics across the landscape that then reduce the likelihood that wildfires and/or insect epidemics will cause large, rapid changes in biophysical conditions. The proposed treatments can modify fire behavior sufficiently so that some wildfires can be suppressed more easily. However, it will take subsequent, sustained fuel treatments (ones that do not increase ladder fuels, crown canopies or surface fuels) to maintain favorable stand and fuel conditions on the landscape. The proposed action will also alter stand conditions that promote healthier growing conditions that reduce the likelihood for epidemic beetle outbreaks. Cumulative effects are therefore focused on changes to these conditions and whether there would be a cumulative increased or decreased ability to sustain the forested systems in the project landscapes.

The no action alternative has limited activities that can alter the project area landscape from existing to desired stand and fuel structures. The cumulative effect from past, present, and reasonably foreseeable future actions has created a downward trend in forest sustainability. Tree densities, ladder fuels, surface fuels and crown canopies are expected to increase with continued fire suppression and limited management. This increases the risk for large stand replacement disturbances (wild fires, insects, diseases) reducing the ability to sustain the forest. Conversely, the proposed action decreases tree densities, ladder fuels, and crown canopy which decrease the risk for large stand replacement disturbances, thus increasing the ability to sustain the forest.

The objective of fuel reduction within the project area cannot be to “fireproof”, “insect proof” or “windproof” the environment, but rather to reduce the likelihood of stand-replacement disturbances such as crown fire (change fire behavior) or epidemic beetle mortality. Fires, insect damage and wind damage will still continue but the cumulative effects of regeneration harvest, thinning from below (commercially and non commercially), and aspen and willow stand enhancement combined with treating the resultant activity fuels can reduce future fire and beetle effects.

Mitigations Included under All Alternatives for all Issues
None Identified.

Additional Mitigations for Consideration for all Issues
None Identified

Short-term Uses vs. Long-term Productivity of all Alternatives for all Issues
None identified.

Irreversible/Irretrievable Commitments of all Alternative for all Issues
None identified.

Unavoidable Adverse Effects of all Alternatives for all Issues
None identified.

Forest Plan Consistency of Action Alternative for all Issues
Implementation of the proposed action alternative for all Issues is consistent with the 1986 Custer Forest Plan goals, objectives, and standards.

Other Required Disclosures under the no Action Alternative for Issue #1
None identified.

Current Guidance, Important to the Resource (FSM, FSH, other laws and regulations)
There are nine acts and a Code of Federal Regulations (CFR's) that give basic authority for silvicultural practices on National Forest System lands.

- Organic Administration Act of 1897 (30 Stat. 34, as supplemented and amended; 16 U.S.C. 473-478).
- Knutson-Vandenberg Act of 1930 (46 Stat. 527, as amended; 16 U.S.C. 576-576b).
- Bankhead-Jones Farm Tenant Act of 1937 (50 Stat. 525, as amended; 7 U.S.C. 1010-1012).
- Anderson-Mansfield Reforestation and Revegetation Act of 1949 (63 Stat. 762; 16 U.S.C. 581j-581k).
- Granger-Thye Act of 1950 (64 Stat. 82, as amended; 16 U.S.C. 490).
- Multiple-Use Sustained-Yield Act of 1960 (P.L. 86-517, 74 Stat. 215; 16 U.S.C. 528-531).
- Supplemental National Forest Reforestation Fund Act of 1972 (87 Stat. 242, 245, as amended; 16 U.S.C. 576C-576e).
- Forest and Rangeland Renewable Resources Planning Act of 1974 (88 Stat. 476, as amended; 16 U.S.C. 1601-1610).
- National Forest Management Act of 1976 (90 Stat. 2949; 16 U.S.C. 1600 (note)).
- Reforestation Trust Fund, Title III - Reforestation, Recreation Boating Safety and Facilities Improvement Act of 1980 (16 U.S.C. 1606a, as amended).
- Title 36 Code of Federal Regulations, Part 219 - Planning. CFR's 219.15, 219.27(b), and 219.27 (c).

All of these acts and CFR's direct the way the agency will carry out silvicultural practices. These mandate to us the harvesting systems in accordance with regeneration requirements and timelines, a continuous supply of timber for the use and necessities for citizens of the United States, allowable collections from purchasers to carry out post sale

work, land conservation, land utilization, timber suitability determination, and multiple use and sustained yield of our National Forest resources.

Forest Service Handbook Policy for Silvicultural Practices

Silvicultural practices in Region 1 are those activities that control the establishment, composition, structure and function of forested ecosystems. Correct silvicultural practices must be used whenever management activities such as cutting or burning will modify forest vegetation. Silvicultural practices are employed in the management of all forest resources including timber, water, forage, wildlife and recreation. They are based upon application of scientific knowledge and experience and are specified through silvicultural prescriptions prepared or approved by a certified silviculturist.

Silvicultural practices must be implemented with the involvement and consultation of a certified silviculturist.

Silvicultural practices will be monitored and evaluated for biological and ecological soundness and for effectiveness in meeting resource needs. The effectiveness of silvicultural practice will be judged primarily on the basis of average stand attributes, and the ability of these attributes to sustain the ecological composition, structure and function of the larger ecosystem.

Reforestation is a silvicultural practice critical to the successful management of all forest resources. The laws and regulations allowing timber harvest on National Forest lands include both expressed and implied mandates to reforest.

The focus of silvicultural practice is the forest stand and the relationship the stand has with the landscape it is located within. A stand represents a relatively uniform forest plant community that occupies a specific area of land.

Stand management is carried out by manipulating species composition, stand density and stand structure to provide conditions that best satisfy resource management objectives while sustaining the function of the ecosystem.

Species Composition. Seral species adaptable to the site will usually be favored where they have historically maintained a role in the composition of the ecosystem. These are generally least affected by insects, disease, fire and wind damage.

Stand Density. The objective of stand management is to provide stocking rates over time that sustain ecosystem function, capture as much potential productivity as possible and still meet all other management requirements.

Stand Structure. The form of the forest produced by silvicultural practice should generally maintain the ecosystem composition and structure within the natural range of variation to sustain ecosystem function, benefit forest resources and at the same time provide protection from unnatural levels of damaging agents. This often requires some

compromise with resource objectives that, in the long run, should favor stand and ecosystem health. Multiple storied stands will normally not be developed where insects and diseases that can be transmitted vertically between canopy levels are likely to occur, unless that structure is required to sustain a historically important ecosystem function.

Ecosystem management is the context in which silviculture must be practiced. In recognizing the importance of ecosystem hierarchy, treatments will be undertaken to support ecosystem functions at scales broader than the stand level.

Additional Policy and Regulation for Reforestation and Silvicultural Prescriptions

The National Forest Management Act of 1976, Forest and Rangeland Renewable Resources Planning Act or 1974, 36 CFR 219.14, 36 CFR 219.27 (c) 6, 36 CFR 219.27 (c) 3, Custer National Forest and National Grasslands Land and Resources Management Plan, Forest Service Manuals and Handbooks are very specific on timeframes and monitoring requirements following management and natural disturbances. The policy is that all forested lands in the NFS be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans. This is policy for both suitable and unsuitable lands.

Time frames for adequate restocking within 5 years of final harvest are specific to lands to be managed for timber production as stated in Forest Service Handbook 2409.17, 2.2. When seed or shelter trees will be carried through the rotation the initial seed cut is considered final cut.

Forest Service Handbook 2409.17, 2.2 states reforestation needs arising from disturbances such as fire, weather, insect, and disease shall have an analysis done to determine long-term objectives of the land based on the forest plan. Developing site-specific reforestation requirements is part of this analysis. The silvicultural prescriptions shall explicitly state time frames. Where reforestation is required, design treatments to achieve satisfactory stocking promptly.

Direction from Forest Service Handbook 2409.17, 2.2 allows for time frames for reforestation to be decided by silvicultural prescription on unsuitable lands. Regenerate in a manner consistent with the land management objectives and the NEPA decision; document time frames as well as species in the silvicultural prescription. When regeneration is required, regenerate promptly to avoid further site preparation costs and regeneration delays. These Acts, Handbooks and Manual excerpts can be found at the District office.

Forest Service Manual 2472.33 directs to include adequate protection measures in the reforestation prescription and that if there is known problems and protection measures cannot be implemented, harvesting or reforestation treatments should be deferred. It is more specific on the control of livestock grazing to achieve successful reforestation.

Policy is to not permit livestock on a reforestation area until seedlings are capable of withstanding the type of grazing use intended.

Forest Service Manual 2478.03 states that the preparation of silvicultural prescriptions detailing the methods, techniques, and timing of the silvicultural activities necessary to achieve established objectives are required prior to initiating any silvicultural treatment on National Forest lands. Forest Service Manual 2470.3 further directs to use only those silvicultural practices that are best suited to the land management objectives for the area, while considering all resources, as directed in the forest plan. Treatments should be prescribed that are practical in terms of the cost of preparation, administration, transportation systems, and logging methods. These practices should be monitored using procedures specified in Forest Plan to ensure that the objectives are met.

Integrating Management Tools, Ecological Knowledge, and Silviculture

Forest management has become highly technical over the years and more so in the last few years with ecosystem and restoration management concepts. Natural forests are in a constant state of disturbance and regrowth, rather than in a stable, steady state as previously thought. The contemporary social attitude is to reduce the extremes of natural and man caused "boom and bust" cycles that affect animal and plant populations. We need to apply specific measurable criteria at the landscape, stand structure, and operational levels to reduce the extremes and achieve desired social goals. Active management is needed to maintain the targeted array of stand structures and landscape patterns by doing specific silvicultural operations at specific times. Several discrete steps are involved: (1) identify the measurable criteria to be targeted. (2) Determine existing stand structures and landscape patterns. (3) Develop alternative silvicultural systems suitable for each stand. (4) Project the changing stand structures and landscape patterns resulting from the alternative systems. (5) Analyze the alternative systems and select the best one for each stand. (6) Implement the operations. (7) Monitor the results to ensure that objectives are achieved. Each step can be performed with varying degrees of detail, technical sophistication, and precision. The process may begin with incomplete knowledge, but adaptive management techniques can be used to make improvements along the way.

APPENDIX I

FOREST STRATA CODES AND DEFINITIONS

Forest Strata	Forested Species	Strata Definition
LP12	Lodgepole pine	Capable of producing industrial wood; **sawtimber** >9" dbh; 10-39% crown cover.
LP13	Lodgepole pine	Capable of producing industrial wood; **sawtimber** >9" dbh; 40-69% crown cover.
LP14	Lodgepole pine	Capable of producing industrial wood; **sawtimber** >9" dbh; 70-100% crown cover.
LP22	Lodgepole pine	Capable of producing industrial wood; **pole timber** 5 – 8.9" dbh; 10-39% crown cover.
LP23	Lodgepole pine	Capable of producing industrial wood; **pole timber** 5 – 8.9" dbh; 40-69% crown cover.
LP24	Lodgepole pine	Capable of producing industrial wood; **pole timber** 5 – 8.9" dbh; 70-100% crown cover.
LP33	Lodgepole pine	Capable of producing industrial wood; **seedlng/sapling** 0-4.9" dbh; 40-69% crown cover.
LP34	Lodgepole pine	Capable of producing industrial wood; **seedlng/sapling** 0-4.9" dbh; 70-100% crown cover.
LP44	Lodgepole pine	Non stocked, forest land at least 10 percent stocked with growing stock.
LP54	Lodgepole pine	Not capable of producing industrial wood; **sawtimber** >9" dbh; 70-100% crown cover.
DF12	Douglas fir	Capable of producing industrial wood; **sawtimber** >9" dbh; 10-39% crown cover.
DF14	Douglas fir	Capable of producing industrial wood; **sawtimber** >9" dbh; 70-100% crown cover.
DF24	Douglas fir	Capable of producing industrial wood; **pole timber** 5 – 8.9" dbh; 70-100% crown cover.
DF53	Douglas fir	Not capable of producing industrial wood; **sawtimber** >9" dbh; 40-69% crown cover.
LPDF54	Lodgepole pine Douglas fir	Capable of producing industrial wood; **sawtimber** >9" dbh; 70-100% crown cover. 50/50 LP and DF
PF12	Limber pine	Capable of producing industrial wood; **sawtimber** >9" dbh; 10-39% crown cover.
PF21	Limber pine	Capable of producing industrial wood; **pole timber** 5 – 8.9" dbh; <10% crown cover.
SAF14	Sub alpine fire and Spruce	Capable of producing industrial wood; **sawtimber** >9" dbh; 70-100% crown cover.
QA12	Aspen	Mature; medium to well stocked; 40-60% crown cover.
00072	Sagebrush shrubland	Sagebrush shrubland.
00074	Non forest - dry grassland	Dry grassland or meadow.
0075	Non forest – wet grassland	Wet grassland or meadow.
00085	Non forest - water	Water.

APPENDIX II
GLOSSARY

Biomass: The total mass of living matter within a given volume of environment.

Blowout: A hole made in the canopy by prescribed fire that results in nearly one hundred percent mortality of all conifers.

Board Feet (BF): A unit of measurement equal to an unfinished board one foot square by one inch thick.

Canopy: More or less continuous cover of branches and foliage formed collectively by the crown of adjacent trees and other woody growth.

Catface: An opening at the base of trees due to the burning of the bark, cambium and sapwood.

Climax Vegetation: The culminating stage in plant succession for a given site where the composition of the vegetation has reached a highly stable condition over time and perpetuates itself unless disturbed by outside forces.

Commercial Thin: An intermediate (mid-rotation) stand tending treatment which harvests commercial sized lower crown classes with the objective of improving growth, vigor and/or value until at the end of the rotation. A commercial thin is not a regeneration treatment.

Cover: Vegetation used by wildlife for protection from predators, or to adverse weather conditions, or in which to reproduce. The different types are identified as hiding cover, thermal cover, and security areas.

Cumulative Effect: The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can also result from individually minor but collectively significant actions taking place over a period of time.

Diameter at Breast Height (dbh): A diameter measurement of a tree made at a point 4.5 feet above the ground surface.

Direct Effects: effects, which are caused by the action and occur at the same time and place.

Disturbance: A discrete event, either natural or human induced, that causes a change in the existing condition of an ecological system.

Doghair: A stand structure condition that typically has many trees per acre (generally greater than 600) of the larger sapling (>3 inches dbh) and immature pole (5-6 inches dbh) sized trees.

Duff Layer: A layer of dead plant material that has fallen to the soil (ground) surface and has accumulated over several growing seasons. This fallen plant material is in the different stages of decay that ultimately results in the return of nutrients and minerals to the soil and living plants.

Ecosystem Burn: Treatment of fire dependent ecosystems to meet multi resource objectives identified in the Custer National Forest and National Grasslands Land and Resource Management Plan.

Ecosystem: Living organisms interacting with each other and with their physical environment, usually described as an area for which it is meaningful to address these interrelationships.

Effects (or impacts: Environmental consequences (the scientific and analytical basis for comparison of alternatives) as a result of a proposed action. Effects may be either direct, which are caused by the action and occur at the same time and place, indirect, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable, or cumulative.

Endemic: The population of potentially injurious plants, animals, or diseases that are at their normal, balanced level, in contrast to epidemic.

Epidemic: The population of potentially injurious plants, animals, or diseases that are widely prevalent, and exceed their normal, balanced level, in contrast to endemic levels.

Even-aged: A stand of trees of essentially the same age, growing together.

Forage: Vegetation used for food by wildlife, particularly big game wildlife and domestic livestock.

Fuels: Combustible materials present in the forest, which potentially contribute a significant fire hazard.

Habitat Type: (Vegetative). An aggregation of all land areas potentially capable of producing similar plant communities at climax.

High Risk: Individual or groups of trees that are live (green) but have the physical characteristics favorable to insect or disease caused mortality. Trees in this category are subject to mortality and loss of economic value in the short term.

Indirect Effects: Secondary effects which occur in locations other than the initial action or significantly later in time.

Intensive Grazing Management: Grazing management that controls distribution of cattle and duration of use on the range, usually by fences, so parts of the range are rested during the growing season.

Ladder Fuels: Fuels that provide vertical continuity and enable surface fires to reach upper forest canopy levels.

Landscape: A heterogeneous land area composed of a cluster of interacting ecosystems that are repeated in similar form throughout. Landscapes vary in size from many thousands of acres to only a few acres.

Lopping: Methods of modifying fuels to allow for primary fuel treatment accomplishment and/or to speed natural abatement. Maybe a primary fuel treatment when no other treatments are planned.

Management Area (MA): Geographic areas, not necessarily contiguous, which have common management direction, consistent with the Forest Plan allocations.

Management Direction: A statement of multiple use and other goals and objectives, along with the associated management prescriptions and standards and guidelines to direct resource management.

Mature Timber: On lands allocated for timber harvest, and for the purpose of this project, mature is defined as trees or stands in which average annual stand growth has culminated, generally 80 to 100 years. In the context of wildlife - Mature forest habitat with characteristics needed to provide habitat for certain wildlife species such as the Goshawk.

Merchantable: Timber that meets minimum size and quality standards.

Mineral Soil: Soil that is exposed; that there is no living or dead plant material covering the ground surface.

Mitigation: Actions to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.

Monitoring and Evaluation: The evaluation, on a sample basis, of Forest Plan management practices to determine how well objectives are being met, as well as the effects of those management practices on the land and environment.

Mortality: Trees of commercial species, standing or down, that have died during a specific period, and were not cull trees at the time of death.

National Forest Management Act (NFMA): Law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring preparation of Regional Guides and Forest Plans, and the preparation of regulations to guide that development.

Natural Regeneration: Renewal of a tree crop by natural means using natural seed fall.

Natural Slash: Accumulations of material in a stand due to the lack of fire, natural dying, overstocking, etc.

No-Action Alternative: The No-Action Alternative is required by regulations implementing the National Environmental Policy Act (NEPA) (40 CFR 1502.14). The No-Action Alternative provides a baseline for estimating the effects of other alternatives. Where a project activity is being evaluated, the No-Action Alternative is defined as one where current management direction would continue unchanged.

Overmature Timber: For the purpose of this project, overmature stands are considered to be approximately 120 years of age or greater, average annual stand growth has culminated, or in which mortality often exceeds growth.

Overstory: The portion of trees in a forest, which forms the uppermost layer of foliage.

Multistory: A stand of trees that has more than two canopy heights.

Precommercial Thin (PCT): The select felling, deadening or removal of trees in a sound stand primarily to accelerate height and diameter growth on the remaining stems, maintain specific species, stocking and/or stand density and improve vigor and quality of the trees that remain.

Preferred Alternative: That alternative which, after assessment of the environmental effects of an action, or actions, is chosen by the Forest Service as the environmentally preferred course of action.

Prescribed Burning: The intentional application of fire to wildland fuels in either the natural or modified state under such conditions as to allow the fire to be confined to a predetermined area and at the same time to produce the intensity of heat and rate of spread required to further certain planned objectives (i.e., silviculture, wildlife management, reduction of fuel hazard, etc.).

Prescribed Fire: A wildland fire burning under preplanned specified conditions to accomplish specific planned objectives. It may result from either a planned or unplanned ignition.

Prescription: Management practices selected and scheduled for application on a designated area to attain specific goals and objectives.

Proposed Action: A proposal by the Forest Service to authorize, recommend, or implement an action.

Purpose and Need: A statement, which briefly specifies the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action. (40 CFR 1502.13)

Reforestation: The natural or artificial restocking of an area with forest trees; including measures to obtain natural regeneration, as well as tree planting and seeding. The work is done on National Forests to produce timber and other forest products, protect watershed functioning, prevent erosion, and improve other social and economic values of the forests, such as wildlife, recreation, and natural beauty.

Regeneration: The renewal of a tree crop, whether by natural or artificial means. This term may also refer to the crop (seedlings, saplings) itself.

Regeneration Harvest: Used in reference to clear-cut, seed tree and shelterwood harvest methods, which remove an existing, stand to prepare a site for regeneration.

Uneven-aged: Stands of trees of many age and sizes, growing together.

Sawtimber: Trees containing at least one 12-foot sawlog or two noncontiguous 8-foot logs, and meeting regional specifications for freedom from defect. Ponderosa pine trees must be at least 7 inches in diameter at breast height.

Scoping: The procedures by which the Forest Service determines the extent of analysis necessary for a proposed action, i.e. , the range of actions, alternatives, and impacts to be addressed, identification of significant issues related to a proposed action, and establishing the depth of environmental analysis, data, and task assignments needed.

Seedlings and Saplings: Non-commercial size young trees, generally occurring in plantations. Seedlings and saplings are from zero to five inches diameter at breast height. Seedlings are generally considered less than 1.0 inches diameter at breast height.

Seral Stage: A transitory or developmental stage of a biotic community in an ecological succession (does not include climax successional stage or pioneer stage).

Silviculturist: A person that uses theory and experience to direct forest establishment, composition, and growth for the production of forest resources to meet specific management objectives.

Silvicultural System: A management process whereby forests are tended, harvested, and replaced, resulting in a forest of distinctive form. Systems are classified according to the method of carrying out the cuttings that remove the mature crop and provide for regeneration, and according to the type of forest thereby produced.

Site Preparation: A general term for a variety of activities that allow site establishment of regeneration such as removal or treatment of competing vegetation, slash, and other debris that may inhibit the establishment of regeneration.

Slash: The residue left on the ground after felling and other silvicultural operations and/or accumulating there as a result of storm, fire, girdling, or poisoning of trees.

Snag: A standing dead tree usually without merchantable value for timber products, but may have characteristics of benefit to some cavity nesting wildlife species.

Stand: A community of trees or other vegetation uniform in composition, constitution, spatial arrangement, or condition to be distinguishable from adjacent communities.

Stocking: The degree to which trees occupy the land, measured by basal area and/or number of trees by size and spacing, compared with a stocking standard; that is, the basal area and/or number of trees required to fully utilize the land's growth potential.

Successional Stage: A stage or recognizable condition of a plant community which occurs during its development from bare ground to climax.

Suitable Forest Land: Forest land (as defined in CFR 219.3, 219.14) for which technology is available that will ensure timber production without irreversible resource damage to soils, productivity, or watershed conditions; for which there is reasonable assurance that such lands can be adequately restocked (as provided in CFR 219.4); and for which there is management direction that indicates that timber production is an appropriate use of that area.

Tentatively Suitable Forest Sites: Those ponderosa forested lands that were tentatively classified; through a combination of photo interpretation and ground inventory, as suitable lands that were predominately on moist, cool aspects and where stocking could be reasonably reassured within 5 years after treatment.

Tentatively Unsuitable Forests Sites**:** Those ponderosa forested lands that were tentatively classified; through a combination of photo interpretation and ground inventory, as suitable lands that were predominately on hot, dry southern aspects and where stocking could be reasonably reassured within 5 years after treatment.

Thinning: Cutting to redistribute growth potential or benefit the quality of the residual stand.

Understory: Vegetation (trees or shrubs) growing under the canopy formed by taller trees.

Uneven-age Management: The application of a combination of actions needed to simultaneously maintain continuous high-forest cover. Cutting methods that develop and maintain uneven-aged stands are individual-tree and group selection.

Unsuitable Forest Land: Lands not selected for timber production suitability during the development of the Forest Plan due to: (1) the multiple-use objectives for the alternative preclude timber production; (2) other management objectives for the alternative limit timber production activities to the point where management requirements set forth in 36 CFR 219.27 cannot be met; and (3) the lands are not cost-efficient over planning horizon in meeting forest objectives that include timber production shall be designated as unsuitable in the Forest Plan.

Wildfire or Wildland Fire: Any wildfire not designated and managed as a prescribed fire with an approved prescription.

Woody Draw: A classification of areas, particularly in grassland settings, where an overstory of woody vegetation in small drainages creates habitat for many wildlife species and shade/wind protection and forage for livestock. The vegetation is a result of higher moisture conditions that in the surrounding area but surface water if any, running through the area is generally short term.

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APPENDIX V

Design Criteria

Project design criteria and the units to which project design features apply		
Project Design Criteria Item	**Description of Project Design Criteria**	**Units to which Project Design Criteria Apply**

Silviculture

1	Reforestation: Ensure every treatment unit receiving a regeneration harvest on suitable lands will meet or surpass stocking guidelines and certification standards within 5 years. Large openings created by prescribed burning on suitable lands will be monitored to ensure restocking. Purpose: Meet National Forest Management Act and Forest Plan Monitoring requirements.	All proposed action activities

APPENDIX VI

Sale Area Improvement Opportunities and Hazard Reduction Activities By Order of Priority

The following is a list of proposed activities by priority that would have potential to be funded with Knutson Vandenberg (KV) funds from any commercial sale receipts. Funding could be a combination of KV, BD, Partnerships and appropriated funds to meet the multiple objectives.

Required KV

- Site preparation (slashing and mechanical scarification) activities for natural regeneration on forestlands.
- Monitoring for natural regeneration on forestlands.

Appropriate KV

- Rehabilitation of landings.
- Monitoring for new noxious weed infestations on sale area treatments.
- Timber stand improvement activities and associated fuel treatments ***within*** commercial harvested units.
- Mechanical and manual fuels treatment activities ***outside*** commercial harvest units.
- Treatments of existing noxious weed infestations.
- Willow restoration.
- Wildlife habitat improvement in Aspen stands.
- Big game habitat improvement (conifer colonization removal) non forest ecosystems.

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