United States Department of Agriculture
Forest Service

Grasshopper Restoration Project

Vegetation Report

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for:
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1.0 Introduction

This report is for the Vegetative resource to inform the effects analysis for Grasshopper project. This report will disclose the effect on the vegetative resource measured through 4 indicators. The indicators are acres of treatment within plant association or plant community, changes to forest structure and composition, effects on residual trees, and effects on insect and disease processes and other disturbances. Vegetative treatments were designed to mitigate or minimize impacts through project design criteria (PDC) and individual unit prescription of different density reduction intensity levels. All proposed activities are consistent with law, regulation, and policy including the Mt. Hood National Forest Land and Resource Management Plan as amended (Forest Plan) which is incorporated by reference.

Overall both Alternative 1 ("the proposed action") and Alternative 2 (the "shelterwood alternative") support the purpose and need of the project. Dry mix conifer stands would be moved toward more historic density levels and open stand structures. In both alternatives moist mix conifer stands would provide for open defensible space and lower density levels while still providing for a mosaic of stand structures. Stand and planning area density levels are reduced in both action alternatives, allowing for new age classes to establish and grow while mitigating the potential loss of older trees and stand components to a large scale event.

2.0 – Analysis Framework

2.1 - Resource Indicators and Measures

The current condition of the vegetation resource as described in this report serves as the baseline against which to measure changes to the vegetation after treatments. Criteria used to determine effects on vegetation include:

1. Total acres treated and acres treated within each plant association or plant community;
2. Changes in forest structure and composition;
3. Effects on residual trees; and
4. Effects on ecological and insect and disease processes, and other disturbances.

This report analyzes these effects at a landscape scale and a site-specific scale. At the landscape scale, criteria used for the effects analysis include the first two criteria listed above (*total acres treated and acres treated within each plant association or plant community* and *changes in forest structure and composition)*. For the site-specific scale, all four criteria are used for the effects analysis.

The proposed roads treatments and all required project design criteria have no direct or indirect effects to the vegetation. As such, this report only analyzes the impacts of the vegetation management treatment.

2.2 - Methodology

The intent of this report is to analyze how the vegetation resources would be affected by the management actions proposed by the U.S. Forest Service as part of the Grasshopper Restoration Project. Existing conditions and effects analyses were assessed at both the landscape and site-specific scale. Professional judgment, relevant research, remotely sensed data and stand level data were used in determining the project's potential effects.

2.2.1 Landscape Scale

The boundary of the White River Watershed and the Upper Badger Creek Subwatershed (within the Tygh Creek Watershed) was selected as the basis for the landscape scale analysis for this project. Information on the vegetative conditions of this larger landscape, of which the Grasshopper Restoration Project is within, is provided by White River Watershed Analysis for the Mt Hood National Forest, and the most recent Gradient Nearest Neighbor (GNN) Structure dataset provided by the Landscape Ecology, Modeling, Mapping & Analysis (LEMMA) collaborative research group.

The White River Watershed Analysis characterizes resource conditions at their respective scales, identifies issues, discusses trends and changes in conditions over time, defines desired conditions, and identifies possible management opportunities to be pursued at the project planning level. Only the elements from these analyses, most pertinent to the proposal are discussed in this section. For the complete analysis of vegetation conditions and ecological processes at the landscape scale, refer to the White River Watershed Analysis. The Existing Conditions section of this report provides an additional summary of this landscape information as related to the project.

The LEMMA research group is collaboration between the US Forest Service Northwest Research Station and Oregon State University. LEMMA has collaborated on a variety of projects utilizing Nearest Neighbor (NN) modeling methods. Such modeling methods are based on relations between ground (response) data and mapped (explanatory) data. The GNN structure dataset utilized in this analysis is one variation of NN modeling which utilizes regional vegetation inventory plots and Landsat imagery to create a large scale spatially explicit dataset, which describes a variety of vegetative characteristics. For more information on the LEMMA group and complete description of the GNN datasets, refer to the LEMMA website (https://lemma.forestry.oregonstate.edu/).

Stand Structure Types

Stand structure types (also known as stand development stages) as described by Oliver and Larsen 1996 and the White River Watershed Analysis were used to describe the landscape and site-specific stand conditions present within the White River Watershed and project area. **Error! Reference source not found.** describes the potential stand types by seral stage and general stand characteristics. These stand characteristics are predicated on the spatial and temporal distribution of trees and other plants within a given stand. Spatial and temporal distributions can be described by species present, vertical or horizontal spatial patterns, size of plants, age, or by any combination of the above. Stand development is the part of stand dynamics concerned with the change in stand structure over time (Oliver and Larson 1996 as amended).

Table 1. Stand Type and Description

Stand Type	Seral Stage	Description
Stand Initiation	Early	Young, single cohort stands whose canopy has not yet closed; seedlings and small saplings; remnant of previous stand may be present.
Stem Exclusion	Early to Mid	Relatively young, single cohort stand whose canopy has closed and thinning has begun; saplings and poles; remnants of previous stand may be present.
Understory Reinitiation	Mid	Middle-aged, medium sized trees with variable canopy closure; second cohort of young trees present in the understory; scattered mortality in all size classes; remnant of previous stand may still be visible.
Mature Stem Exclusion	Mid to Late	Middle-aged medium sized to large trees with closed canopy; crowns of second cohort intermingled with crowns of first cohort such that a second canopy layer is not readily distinguished' scattered mortality; some small clumps of snags may be present.
Late Seral Multistory Closed	Late	Main canopy dominated by older, large trees; canopy closure variable; 2-3 canopy layers distinguishable; mortality both scattered and clumped and in higher proportion of stand than other stages.
Late Seral Open	Late	Main canopy dominated by well-spaced older, large trees; canopy closure variable; 1-2 canopy layers distinguishable; mortality scattered and in less proportion of stand than other stages.

Additionally, with stand structure and seral stages stands can be defined as even aged or uneven aged stand conditions. Even aged stand conditions are typically defined as those where the ages of the trees are generally within about 20% of the average stand age. Even aged stands can be created though both artificial and natural disturbances. Plantation forests are the best example of even-aged stands, as often they are created using seedlings or clones from a common set of parents. The planted trees are all the same age since they are planted at the same time. Uneven-aged stands are those where there are two or more distinct age ranges of trees within a stand (Bettinger 2017).

2.2.2 Site-specific Scale

The project area boundary contains approximately 7,842 acres and falls within the Threemile, Rock, Gate, Boulder, Upper and Lower Badger Creek Subwatersheds. The area contained within the project area boundary serves as the analysis area for disclosing effects at a site-specific level. Information on the vegetative conditions at this site-specific level was provided by Forest stand records and detailed field reviews conducted during the 2018 and 2019 field seasons. GNN was also utilized where no stand records or field reviews were available.

Common Stand Exams

Common stand exams (CSE) were conducted within the project area. CSE provides one set of national data collection protocols, data codes, portable data recorder software, forms, reports, and export programs. All stand examination data is stored in a common database structure, Field Sampled Vegetation (FSVeg). Data from multiple Districts, Forests, Regions, and participating Agencies can be analyzed with ease. The CSE protocols are used to collect stand, plot, tree, surface cover, vegetation, and down woody data. This data is stored in FSVeg along with strategic grid data, insect and disease study data, Forest Inventory and Analysis (FIA), and re-measured growth plot data.

Forest Service Vegetation (FSVeg) Module

FSVeg module contains data that has been collected in the "field." FSVeg contains plot vegetation data from field surveys such as FIA data, stand exams, inventories, and regeneration surveys. It includes data on trees, surface cover, understory vegetation, and down woody material.

Forest Vegetation Simulator

The Forest Vegetation Simulator (FVS) was used to interpret data collected in the CSE. FVS is a growth and yield model used for predicting forest stand dynamics that is used extensively in the United States. FVS is the standard model used by various government agencies, including the U.S. Forest Service. Forest managers have used FVS extensively to summarize current stand conditions, predict future stand conditions under various management alternatives, and update inventory statistics (USDA 2018).

Plant Associations

Field Guide to the Forested Plant Associations of the Oregon East Cascades was used to analyze the effects of proposed treatments. Plant association classification describes repeating patterns of plant communities that indicate different biophysical environments. The combinations of factors, such as light, soil nutrients, moisture and temperature regimes provide habitat for a group of plant species. There are few distinct boundaries across the landscape. Categorizing discrete plant associations is a way to track and predict vegetation composition, structure, and response to disturbance. Plant association classification of forested lands has been a forest management tool for many years. Ecosystem management and concerns with biodiversity also require understanding the plant and animal habitats that occur across our landscapes.

3.0 – Analysis of the Alternatives[1]

3.1 – Existing Condition

3.1.1 - Vegetative Conditions at the Landscape Scale

3.1.1.2 Plant Communities

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[1] All acreages are an estimate calculated using Geographic Information Systems (GIS) from data prepared by the USDA, Forest Service, or from other suppliers. The estimated acres accuracy may vary due to compilation from various sources, including modeling and interpretation. Acreage estimates may be updated, corrected, or otherwise modified to reflect true ground conditions during implementation.

The White River watershed analysis divides the Grasshopper project area into three climatic zones (Crest, Transition, and Eastside). The majority of Grasshopper project area is within the Transition sub-division and has smaller sections within the Crest and Eastside sub-divisions. The Transition sub-division of the watershed is dominated by several vegetative zones including but not limited to Ponderosa pine (Pinus Ponderosa), Douglas-fir (Pseudotsuga menziesii), western larch (Larix occidentalis) western white pine (Pinus monticola) with the climax species of grand fir (Abies grandis) and western hemlock (Tsuga heterophylla). The Eastside subdivision has similar vegetative zone to the transition subdivision with different climax species of Douglas-fir, ponderosa pine, and Oregon white oak (Quercus garryana). The Crest zone is the most productive and biologically diverse climactic zone within the watershed. Favorable moisture and climate provide an area able to support a high diversity of plant and animal species in all successional stages. National Forest System lands make up sixty percent of these watersheds with non-federal ownership as the other principal landowners.

3.1.1.3 Forest Structure and Composition

In general, the watershed is currently comprised of approximately 38% early seral stands (Stand Initiation and Stem Exclusion), 35% mid seral stands (Understory Reinitiation) and 21% late seral stands (Mature Stem Exclusion and Late Seral Multistory). The largest concentration of early seral stands is in the eastern portion of the watershed. Within the federally managed lands in the north western portion of the watershed forest structure types are more equally represented between the seral stages. The southern portion of the watershed represents the area with the highest concentration of late seral stand types (Mature Stem Exclusion and Late Seral Multistory (reference Table 2).

Table 2. Current Stand Structure of Watersheds included in the Grasshopper Project Area*

Stand Structure	Seral Stage	Percent of Watersheds
Stand Initiation	Early	19%**
Stem Exclusion	Early to Mid	19%
Understory Reinitiation	Mid	35%
Mature Stem Exclusion	Mid to Late	16%
Late Seral Multistory Closed	Late	2%
Late Seral Open	Late	3%
Non-Forested	N/A	7%

*Watersheds included are the White River Watershed and Upper Badger Creek Subwatershed
** Percent of early seral conditions include recently disturbed areas from the 2020 White River wildfire.

3.1.2 - Vegetative Conditions at the Site-specific Scale

3.1.2.1 Plant Associations

The project area occurs within the White River watershed and Upper Badger Creek Subwatershed. The proposed treatment areas are in two different moisture regimes (dry mixed and moist mixed conifer)in ten dominant plant associations, Pacific silver fir/vanilla leaf (Abies amabilis/Achlys triphylla), Pacific silver fir/queencup beadlily (Abies amabilis/Clintonia uniflora), Pacific silver fir/thinleaf huckleberry/common beargrass (Abies amabilis/Vaccinium membanaceum/ Xerophyllum tenax), Grand fir/vanilla leaf (Abies grandis/Achlys triphylla), Grand fir/Oceanspray (Abies grandis/Holodiscus discolor), Douglas fir/Elk sedge (Pseudotsuga menziesii/Carex geyeri), Douglas-fir/common snowberry (Pseudotsuga menziesii /Symphoricarpos albus), Western hemlock/Vanilla-leaf (Tsuga heterophylla/Achlys triphylla), Mountain hemlock/Queencup beadlily (Tsuga mertensiana/ Clintonia uniflora) and Mountain hemlock/thinleaf huckleberry/common beargrass (Tsuga mertensiana/ Vaccinium membanaceum/Xerophyllum tenax).

Most of the project area falls in A3 (Pacific silver fir/thinleaf huckleberry/common beargrass), A4 (Grand fir/vanilla leaf), and A10 (Mountain hemlock/thinleaf huckleberry/common beargrass). Grand fir and Douglas fir make up a majority of the overstory for the Grand fir/vanilla leaf (A4) plant association. A4 sits in the 2440-5300 elevation band and receives around 25-83 inches of precipitation annually. Cascade Oregon-grape (Berberis nervosa), prince's pine (Chimaphila umbrellata) and dwarf rose (Rosa gymnocarpa) are the most common understory species. This can be a highly productive site with grand fir and Douglas fir reaching heights between 126-133 feet within 100 years. The overstory of the Pacific silver fir/thinleaf huckleberry/common beargrass (A3) and Mountain hemlock/thinleaf huckleberry/common beargrass (A10) plant associations are dominated by pacific silver fir and mountain hemlock. A3 and A10 in the 3600-6000 foot elevation band and receive 43-117 inches of precipitation annually. The most common understory species for these plant associations are thinleaf huckleberry (Vaccinium membranaceum) and prince's pine. These sites are not very productive with pacific sliver fir and mountain hemlock reaching 57-66 feet within 100 years. In addition to the primary plant associations described above there are multiple other plant associations within the project area and within Inventory Roadless Areas which fall within proposed treatment areas (reference Table 3).

Table 3. Plant associations by acre within the Grasshopper Project area

Stand Group	Plant Association	Acres within proposed treatments	Acres within proposed IRA treatments
A1	Pacific silver fir/vanilla leaf	240	0
A2	Pacific silver fir/queencup beadlily	6	0
A3	Pacific silver fir/thinleaf huckleberry/common beargrass	872	0
A4	Grand fir/vanilla leaf	1955	96
A5	Grand fir/Oceanspray	468	105
A6	Douglas fir/Elk sedge	9	10
A7	Douglas-fir/common snowberry	230	22
A8	Western hemlock/Vanilla-leaf	180	0
A9	Mountain hemlock/Queencup beadlily	186	0

Stand Group	Plant Association	Acres within proposed treatments	Acres within proposed IRA treatments
A10	Mountain hemlock/thinleaf huckleberry/common beargrass	1220	39
	Total	5366	272

3.1.2.2 - Forest Structure and Composition

The project area contains a mix of immature and mature stands ranging in age from less than 20 years to over 200 years (reference

Table 5). The stand structure is also mixed throughout the project area with most of the project area being in the understory regeneration phase (reference Table 4). Stands within the project area are quite varied, with small to large sized trees and quadratic mean diameters (QMD) ranging from as low 2 inches to as high as 19 inches with an average dominant tree height of 84 feet. There are isolated stands with larger trees, but these are infrequent and represent a small portion of the project area. Canopy cover averages approximately 62% for the project area. There are approximately 4.2, 18 inch and greater diameter-at-breast-height (DBH) snags per acre and 8.2, 12 inch DBH and greater snags per acre across all dominant plant associations.

Table 4. Current percent of stand structure within the project area

Stand Structure	Seral Stage	Percent of the Project Area
Stand Initiation	Early	15%
Stem Exclusion	Early to Mid	19%
Understory Reinitiation	Mid	43%
Mature Stem Exclusion	Mid to Late	15%
Late Seral Multistory Closed	Late	2%
Late Seral Open	Late	<1%
Non-Forested	N/A	5%

Table 5. Current percent of age class within the project area

Age Class	Percent
< 20 Years	3%
21-40 Years	6%
41-60 Years	8%
61-80 Years	3%
81-120 Years	45%
121-160 Years	24%
161-200 Years	8%
200 + Years	3%

3.1.2.4 –Ecological and insect and disease processes, and other disturbance

Ecological processes and disturbances directly affect the diversity of plant and animal communities within an area over space and time. Ecological processes and disturbances include nutrient and biomass cycling, forest succession (the change in vegetation over time), weather events (i.e., windstorms), insects, pathogens, fire, and human influences (i.e., timber harvest).

Over the last century, there have been broad changes in vegetative conditions in the Cascade Range. The disturbances, or agents of change, influencing vegetation in the project area include fire, diseases, insects and timber harvest. Of these agents, fire and timber harvest have played the most active recent role in the project area, with most of the land base being burned over or harvested at some point after early 1900s. Presently, these regenerated stands tend to be in an overstocked condition (USDA 1995). For a complete description of fire conditions refer to the Fuels Report which is incorporated by reference and included on the project website. A brief discussion of insects, diseases, and timber harvesting follows below.

Insects and Disease

Insects and diseases can be natural elements of the ecosystem that can exert equal, if not greater, influence on forest development and conditions as fire. Most of these organisms have co-evolved with their host species over thousands of years. The balance between forests and their major pathogens is dynamic and fluctuates through time. In the past, with regular small scale disturbances like floods, they have probably existed most commonly at endemic levels (i.e., present in an area but causing low or moderate levels of mortality). Population fluctuations were normal with epidemic conditions of some insects or diseases developing periodically and causing high levels of tree mortality over short periods (Harvey et al. 1995). In addition to the native insects there is also a non-native insect impacting the project area. The balsam woolly adelgid is a non-native insect that has the potential to slowly eliminate true fir species from an area.

Spruce Budworm (Choristoneura occidentalis)

The spruce budworm is found throughout Oregon and Washington, however, most outbreaks occur east of the Cascade Mountains crest. Larvae consume current-year foliage. They also feed on flowers and developing cones, and sever the current-year shoots of western larch. Branch dieback and topkill begin to occur following two years of heavy defoliation. Sustained heavy feeding for 4 or 5 years can cause complete defoliation and tree mortality. The project area has seen epidemic levels of this insect activity as recently as the 1990’s, however, current trends indicate a decreasing population. Even with the current reduction in spruce budworm populations the conditions (species composition and stocking levels) still exist to support future outbreaks (USDA 1996).

Balsam Wooly Adelgid (Adelges piceae)

The balsam woolly adelgid is a tiny sucking insect that was introduced into North America from Europe. In North America, it has caused large amounts of damage and mortality to true firs in both eastern and western forest. Primarily in the West, it occurs in subalpine, Pacific silver, and grand fir. Symptoms of the adelgid attack appears as stunting of terminal growth, swelling around buds and branch nodes, dying foliage, and the trees turn yellow then red or brown. All sizes of trees can be attacked, although trees that are pole-sized or larger seem most susceptible. Due to the fact that it is a non-native species, there are few natural predators or parasites to the adelgid. Weather and environmental factors are important factors in affecting the insect survival. Cold winters and high elevation where there is rarely enough heat accumulation for the insect to complete a second generation. Site conditions and stand age can also play a role in affecting the insect survival, depending on the susceptibility of the host species at that given site. Presently there are only a few isolated locations with the project area that are being impacted by this insect.

Douglas-fir Beetle

Douglas-fir beetles (Dendroctonus pseudotsugae Hopkins) are a bark beetle that as adults tunnel through the bark to construct galleries in the cambial area in which they feed and lay their eggs. When abundant, favorable breeding habitat (weakened trees, moist conditions, etc.) becomes available, usually as windthrow, Douglas-fir bark beetle populations can rise to epidemic levels creating mortality in live trees. Disturbance by insects and disease is closely associated with windthrow. Much like the spruce budworm the project area has seen epidemic levels of this insect activity as recently as the 1990's as well. The current conditions (species composition and stocking levels) still exist to support future outbreaks (USDA 1996).

Dwarf Mistletoe

Dwarf mistletoes are small, leafless, parasitic plants that extract water and nutrients from live conifer trees. They are generally host specific, occurring on one principal species. They cause decreased height and diameter growth, reduction in seed and cone crops, and direct tree mortality or predisposition to other pathogens or insects. Once the dwarf mistletoe has spread throughout the crown, it usually takes ten or more years for tree mortality to occur. There is increasing evidence that important interactions exist between dwarf mistletoe and animals (Hawksworth and Wiens 1996). Birds, porcupines, squirrels, and other animals eat seeds, shoots, and other parts of the plants. The dense branch masses ("witches brooms") caused by dwarf mistletoe provide cover and nesting sites for some birds and mammals. Presently, throughout the project area Douglas-fir dwarf mistletoe (Arceuthobium douglasii) and western hemlock dwarf mistletoe (Arceuthobium tsugense) are present at low levels in the overstory. The potential for mistletoe spread to younger regeneration increases as the understory begins to differentiate and become an established second layer.

Root Disease

The dense, single-canopied Douglas-fir dominated stands in the project area are perfect conditions for the proliferation of root disease. Most of the stands in the watershed have some level of root disease present as laminated and/or Armillaria root rot (Phellinus weirri) and (Armillaria ostoyae). Highly susceptible species include Douglas-fir, grand fir, and mountain hemlock, with moderately susceptible species including noble fir, pacific silver fir, and western hemlock. Species that are tolerant or resistant to laminated root rot include lodgepole pine, western white pine, and western red cedar (Goheen and Willhite 2006). Root disease organisms can cause increased stress, severe reduction in tree growth, and direct or indirect mortality to trees. Trees infected with P. weirii are sometimes killed by bark beetles in combination with other root diseases. The Douglas-fir beetle and fir engraver are commonly associated with laminated root rot (Schowalter and Filip 1993 and Rippy et al. 2005). It is recognized that root decay and stem decay are natural agents processing downed wood and creating a variety of structure in the forest. Though the organisms themselves are a natural and integral part of the ecosystem, the condition of the vegetation across the landscape and within individual stands is in many cases not natural. When there is an abundance of a susceptible species in a stand, root disease centers continue to grow. When there is a wide variety of species in a stand, including some less susceptible species, it may be slowed. Current stand conditions have provided an abundance of susceptible species and available habitat for these organisms (dense Douglas-fir forests) and therefore may cause more severe effects to the forests than has typically occurred in the past.

Timber Harvest

Timber harvesting has been a major contributor to the change in vegetative conditions that have occurred across the project area as well as the White River Watershed and Badger Subwatershed. This has altered the stand structure and species composition within the project area.

In the project area, records show that approximately 3,156 acres have been treated in the past 70 years during the time period from 1950 to 2019 (Reference Table 6). Within the project area the Forest has limited records of federal timber harvest before 1950, however, stand age and structure would indicate that active harvest was occurring during this time.

Table 6. Acres by Harvest Type in the Grasshopper Project Area

Decade	Even Aged Management	Uneven Aged Management	Even Aged Management Within IRA	Uneven Aged Management Within IRA
1950-1959	43	0	0	0
1960-1969	73	0	0	0
1970-1979	298	0	3	0
1980-1989	976	0	2	0
1990-1999	210	417	67	65
2000-2010	286	853	3	56
Total	**1,886**	**1,270**	**75**	**121**

3.2 - Environmental Consequences for Vegetative Resource

3.2.1 – Effects of No Action

No acres would be treated under this alternative. There would be no direct effects to the vegetation at the landscape or site-specific scale in the short-term, which is defined as 50 years from today, including the IRA. The existing condition would be maintained with little change in the current condition relative to forest structure, composition, residual tree densities and insect and disease processes.

In the long-term , which is defined as between 50-100+ years from today, the dry mix conifer stand structure and composition would be dominated by grand fir in the overstory and would remain under-developed with low occurrences of ecologically important tree and shrub species in the understory. The stand structure would remain in a two-story dominant stem exclusion type stand. Young stands would continue to grow in densely stocked conditions with little regeneration. The regeneration that would occur would be dominated by shade tolerant tree and shrub species that are less fire-resistant. Densely stocked stands would continue to have large amounts of small patches with increasing crown closure with little shade intolerant species and minimal structural diversity.

In the long-term, the moist mix conifer stand structure would become dominated by mountain hemlock and pacific silver fir in the overstory, with the development of small patches of ecologically important tree and shrub species in the understory. In unmanaged stands the natural disturbance regime would continue to occur creating small patches of structural diversity. Stand structure would remain in the closed canopy stem exclusion and understory reinitiation phase and move towards a mature stem exclusion type stand.

Ultimately, with no vegetation treatments, the stands would remain in dense overstocked conditions with little understory reinitiation. Vulnerability to insect and disease infestations would remain high and stand density would continue to increase the stands' vulnerability to large scale disturbance. Maintaining high tree density increases both above and below ground competition, creating stress-related mortality. Stems in this environment may continue to grow in height, but diameter growth would stagnate; trees would become more dependent on neighboring trees for support. When stands develop in this manner, they become more susceptible to blow down in large groups, the risk of bark beetle and other insect and disease infestation, and stand replacing events.

Quadratic mean diameter (QMD) is the diameter corresponding to the tree of arithmetic mean basal area, or average diameter by basal area (BA). QMD would slowly increase over time with little fluctuation. This is indicative of stands stagnating in the stem exclusion stage. QMD should fluctuate over time to reflect the regeneration of smaller diameter trees that contribute to the BA. Tree height will continue to increase but will eventually level out due to competition, lack of growing space, site capacity and resources.

Modeled density measurements are shown in Table 7, Table 8, Table 9, and Table 10 and Figure 1, Figure 2, Figure 3, and Figure 4 if no action was taken for the project area including within the IRA. Modeling is based on a representative sample of plantations and non-plantations thinning units within each stand structural stage. Refer to project record or Appendix B of the Environmental Analysis for a complete list of units. The density measurement indicators used below can be used in determining stand health, and productivity as well as providing information relevant to evaluating a stands vulnerability to large scale insect disturbance. The number of trees present, the species composition, and the size of the trees present in the stand indicate the overall health and vigor of the stand. Stands that maintain higher than normal tree densities, for their specific plant association, have less growth, and less species composition.

With less growth the health and vigor of the trees decline, making them more vulnerable to large scale disturbance.

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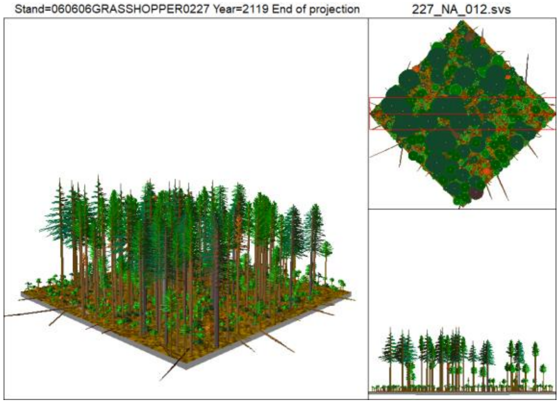

Figure 1. Projected structure 100 years after no treatment is applied for stands currently in the stand initiation stage, including stands within IRA.

Table 7. Resulting density levels in stands currently in the stand initiation stage from FVS modeling of the no action alternative

Time After Treatment	Basal Area (BA) Project Area	Basal Area (BA) Within IRA	Trees per Acre (TPA) Project Area	Trees per Acre (TPA) Within IRA	Quadratic Mean Diameter Project Area	Quadratic Mean Diameter Within IRA	Average Stand Height (feet) Project Area	Average Stand Height (feet) Within IRA
2019	173	180	3279	3360	3.1	3.0	47	50
2069	218	230	1348	1420	5.4	5.3	75	78
2119	274	280	857	940	7.2	7.1	92	94

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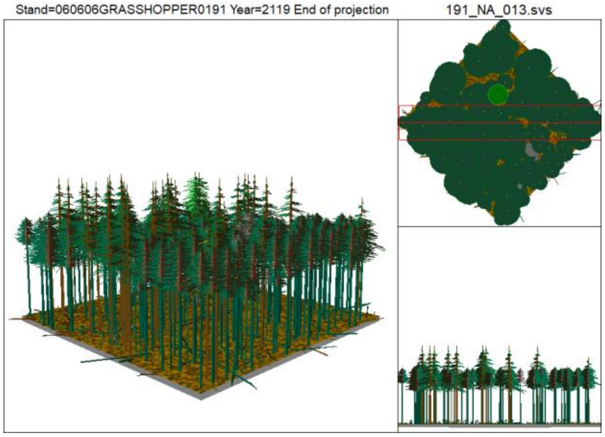

Figure 2. Projected structure 100 years after no treatment is applied for stands currently in the stem exclusion stage. Currently there are no treatments proposed within IRA of stands in the stem exclusion stage.

Table 8. Resulting density levels in stands currently in the stem exclusion stage from FVS modeling of the no action alternative

Time After Treatment	Basal Area (BA) Project Area	Trees per Acre (TPA) Project Area	Quadratic Mean Diameter Project Area	Average Stand Height (feet) Project Area
2019	240	1533	5.4	76
2069	273	956	7.2	98
2119	299	299	9.1	103

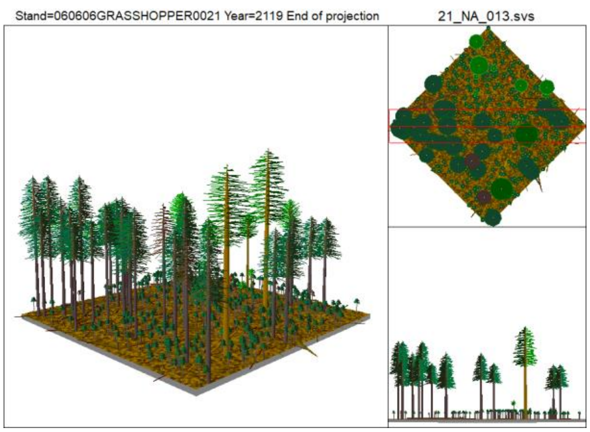

Figure 3. Projected structure 100 years after no treatment is applied for stands currently in the understory reinitiation stage, including stands within IRA.

Table 9. Resulting density levels of stands currently in the understory reinitiation stage from FVS modeling of the no action alternative

Time After Treatment	Basal Area (BA) Project Area	Basal Area (BA) Within IRA	Trees per Acre (TPA) Project Area	Trees per Acre (TPA) Within IRA	Quadratic Mean Diameter Project Area	Quadratic Mean Diameter Within IRA	Average Stand Height (feet) Project Area	Average Stand Height (feet) Within IRA
2019	128	125	1186	222	4.5	11.7	91	85
2069	151	122	595	322	6.8	8.4	94	67
2119	166	123	400	245	8.7	10.1	80	65

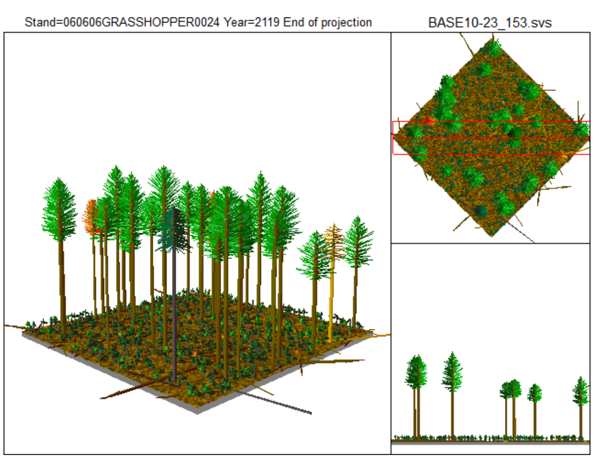

Figure 4. Projected structure 100 years after no treatment is applied for stands currently in the mature stem exclusion stage, including stands within IRA.

Table 10. Resulting density levels of stands currently in the mature stem exclusion stage from FVS modeling of the no action alternative

Time After Treatment	Basal Area (BA) Project Area	Basal Area (BA) Within IRA	Trees per Acre (TPA) Project Area	Trees per Acre (TPA) Within IRA	Quadratic Mean Diameter Project Area	Quadratic Mean Diameter Within IRA	Average Stand Height (feet) Project Area	Average Stand Height (feet) Within IRA
2019	196	165	108	243	18.2	12.1	113	83
2069	192	166	78	408	21.2	8.5	112	87
2119	162	169	57	339	22.7	9.7	110	79

3.2.2 - Direct and Indirect Effects -Alternative 1 (Proposed Action)

3.2.2.1 Vegetative Effects at the Landscape Scale - for Acres Treated within each Plant Community and Forest Structure and Composition

The total effects for this project would be minimal at the landscape scale. The total acreage treated by the variety of proposed thinning activities in the Proposed Action area is approximately 5,360 acres. This is around 70% of the proposed project area and represents less than 3% of the White River Watershed. The Proposed Action alternative treats a variety of dense dry mix conifer and moist mix conifer plant communities within the project area, and it moves the overall landscape vegetation towards a condition that would have occurred under natural small and large scale disturbance regimes. The probability of an epidemic level of insect and disease activity across the landscape would be decreased with the density reductions of the thinning activities. Stands would be moved to more historic vegetation composition and stand structure, which would help ensure that key ecosystem elements and processes are sustained. The acres of late seral and mature stand classes would remain very similar after treatment, due to the fact that stands would be thinned from below and would retain the majority of the large overstory trees.

3.2.2.2 Vegetative Effects at the Site-specific Scale - All Resource Indicators

The Proposed Action would thin from below with a variable density and intermediate thinning on approximately 5,360 acres. Over the first fifty years after treatment several forest types would be moved from mostly dense, closed canopy stem exclusion and mature stem exclusion stages towards more open less dense conditions, stand reinitiation, or open mature stages in both the moist mix conifer and dry mix conifer plant associations, including within the IRA. These conditions would have moderate to low canopy cover with openings large enough to stimulate natural regeneration of shade intolerant tree and shrub species within these types of plant associations. Species diversity in the overstory, seedling, sapling, and shrub layers is essential to the five dominant plant associations mainly present in the treatment areas. However, in the short-term, overstory species diversity would remain limited. Over time as a diversity of species regenerate and became established, the overstory diversity would increase. With the use of (1 to 2 acre) openings, more shade-intolerant trees and shrubs species can become established.

In variable density thinning, selected trees of all sizes down to saplings (i.e., 3-inches or less in diameter) would be removed. The focus would be on leaving the largest most vigorous, healthiest trees, and favoring shade intolerant, more fire tolerant species. Thinning from below must retain some young trees of desired species if stands are to retain a healthy age structure. (Perry et al. 2004). Overall, the average stand diameters would be maintained or increased (Lindh and Muir 2004). In the long-term (100+ years from today), the stand structure would be moved towards a late multistory closed seral stage within moist mix conifer and moved towards late multi story open seral stage in dry mix conifer (refer to Figure 5, Figure 6, Figure 7, and Figure 8).

With vegetation treatments the stand would be less dense with a new mosaic of understory reinitiation (reference to Table 11, Table 12, Table 13, and Table 14) for treatment area. By creating less dense stands with less tree competition, residual trees would benefit from the increased availability of sunlight, nutrients and water. Low stocking levels would result in less volume production, but larger average tree sizes (O'Hara et al. 1995).

Overall with the proposed action treatments, the QMD fluctuates over time from 21.0 inches DBH at the completion of harvest to 9.2 inches DBH 100 years after harvest. This is indicative of stands that have regeneration occurring through time. Stands QMD is fluctuating to reflect the ingrowth of smaller diameter trees that begin to contribute to the stand BA. The stands' Trees per Acres (TPA) and BA also continue to increase, indicative of stands with multiple regeneration cohorts or events. Also Stand Density Index (SDI) increases over time from 133 immediately after treatment to 328. These density measurement indicators are used for evaluating stand health and productivity over time. The density metrics shown below can be used to evaluate the stand's vulnerability to large scale insect disturbances. These measurements are used to determine the stand's response to the thinning in both the long- and short-term. The number of trees present, the species composition, and the size of the trees present in the stand indicate the overall health and vigor of the stand. Stands that maintain higher than normal tree densities, for their specific plant association, have less growth and less species composition. With less growth the health and vigor of the trees decline, making them more vulnerable to insect and disease. In the short term stand densities and species composition create defensible space and move the stands towards more historic species composition and structure. To maintain this defensible space and keep the stands on a more historic trajectory a re-entry thin or other density management activities would be expected every 80-90 years dependent on site conditions and frequency of low intensity fire occurrences.

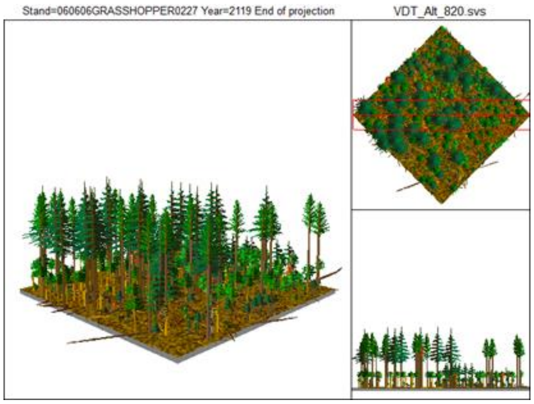

Figure 5. Projected structure 100 years after proposed action treatment is applied for stands currently in the stand initiation stage, including stands within IRA.

Table 11. Resulting density levels in stands currently in the stand initiation stage from FVS modeling of the proposed action alternative

Time After Treatment	Basal Area (BA) Project Area	Basal Area (BA) Within IRA	Trees per Acre (TPA) Project Area	Trees per Acre (TPA) Within IRA	Quadratic Mean Diameter Project Area	Quadratic Mean Diameter Within IRA	Average Stand Height (feet) Project Area	Average Stand Height (feet) Within IRA
2019	80	90	70	80	13.9	14.2	47	50
2069	150	155	588	595	6.9	7.2	75	78
2119	200	200	480	480	8.7	9.0	90	92

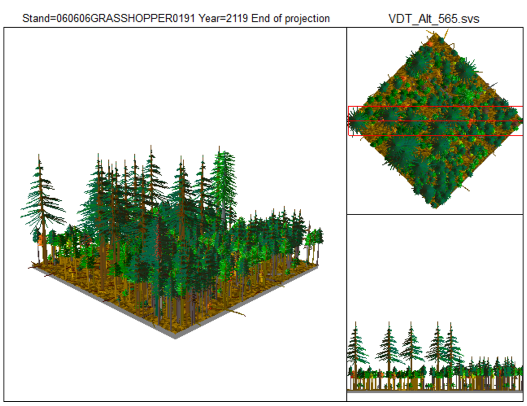

Figure 6. Projected structure 100 years after proposed action treatment is applied for stands currently in the stem exclusion stage. Currently there are no treatments proposed within IRA of stands in the stem exclusion stage.

Table 12. Resulting density levels in stands currently in the stem exclusion stage from FVS modeling of the proposed action alternative

Time After Treatment	Basal Area (BA) Project Area	Trees per Acre (TPA) Project Area	Quadratic Mean Diameter Project Area	Average Stand Height (feet) Project Area
2019	60	50	21.9	74
2069	116	560	6.1	60
2119	220	560	8.6	69

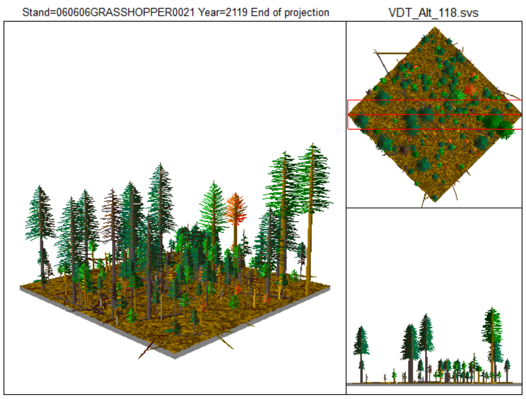

Figure 7. Projected structure 100 years after proposed action treatment is applied for stands currently in the understory reinitiation stage, including stands within IRA.

Table 13. Resulting density levels in stands currently in the understory reinitiation stage from FVS modeling of the proposed action alternative

Time After Treatment	Basal Area (BA) Project Area	Basal Area (BA) Within IRA	Trees per Acre (TPA) Project Area	Trees per Acre (TPA) Within IRA	Quadratic Mean Diameter Project Area	Quadratic Mean Diameter Within IRA	Average Stand Height (feet) Project Area	Average Stand Height (feet) Within IRA
2019	90	100	40	42	21.5	22.7	92	89
2069	106	115	252	345	8.8	8.1	60	57
2119	110	125	158	248	11.3	10.2	60	60

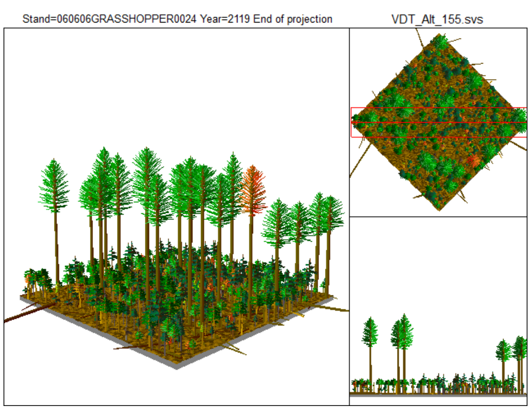

Figure 8. Projected structure 100 years after proposed action treatment is applied for stands currently in the mature stem exclusion stage, including stands within IRA.

Table 14. Resulting density levels in stands currently in the mature stem exclusion stage from FVS modeling of the proposed action alternative.

Time After Treatment	Basal Area (BA) Project Area	Basal Area (BA) Within IRA	Trees per Acre (TPA) Project Area	Trees per Acre (TPA) Within IRA	Quadratic Mean Diameter Project Area	Quadratic Mean Diameter Within IRA	Average Stand Height (feet) Project Area	Average Stand Height (feet) Within IRA
2019	100	93	25	75	26.5	19.4	116	
2069	131	127	568	430	6.5	7.5	76	
2119	158	166	531	387	7.4	9.1	66	

Table 15. Resource indicators and measures of effects on residual tree, insect, and disease processes after proposed action treatment. Modeling is based on a representative sample of plantations and non-plantations thinning units. (Refer to project record for a complete list of units).

Time After Treatment	Existing BA	Proposed Action BA	Existing TPA	Proposed Action TPA	Existing QMD	Proposed Action QMD	Existing Average Stand Height (feet)	Proposed Action Average Stand Height (feet)
2019	175	93	361	80	10.4	21.0	83	86
2069	174	132	450	476	8.3	7.3	89	72
2119	166	171	549	402	7.4	9.2	86	71

Table 16. Resource indicators and measures of effects on residual tree, insect, and disease processes after proposed action treatment. Modeling is based on a representative sample of plantations and non-plantations thinning units within IRA. (Refer to project record for a complete list of units).

Time After Treatment	Existing BA Within IRA	Proposed Action BA Within IRA	Existing TPA Within IRA	Proposed Action TPA Within IRA	Existing QMD Within IRA	Proposed Action QMD Within IRA	Existing Average Stand Height (feet) Within IRA	Proposed Action Average Stand Height (feet) Within IRA
2019	146	97	486	57	11.2	21.2	81	88
2069	140	120	588	385	6.9	7.8	74	63
2119	149	140	418	311	8.9	9.7	72	61

Table 17. Resource indicators and measures for forest structure and composition after proposed action treatment.

Structural Stage	Existing Condition Percent of the Planning Area	Effect of Proposed Action Percent of the Planning Area
Stand Initiation	15%	20%
Stem Exclusion	19%	5%
Understory Reinitiation	43%	50%
Mature Stem Exclusion	15%	10%
Late Seral Multistory Closed	2%	2%
Late Seral Open	0%	8%
Non-Forested	5%	5%

3.2.3 Direct and Indirect Effects -Alternative 2 (Shelterwood Alternative)

3.2.3.1 Vegetative Indicator at the Landscape Scale - Acres Treated within each Plant Community and Forest Structure and Composition

The effects will be the same as described in the proposed action alternative.

3.2.3.2 Vegetative Indicator for the Site Scale – All Resource Indicators

In this alternative, shelterwood treatment would be utilized on approximately 289 acres of C1/Matrix land (compared to the VDT treatment described in Alternative 1 for these acres). There are no proposed shelterwood activities within Inventory Roadless Areas or National Recreation Areas. This treatment would remove the majority of trees. Trees would be left in sufficient densities to provide a beneficial micro-climate within the understory to allow for the development of a new generation of saplings. In general, the canopy cover within treated units would be reduced to approximately 15% to achieve this outcome. This treatment would allow more sunlight to penetrate the forest canopy while still providing limited shading from residual trees. Contiguous treatments of this type would be limited to no more than 40 acres and would be separated by blocks of land that are not classed as created openings and that contain one or more logical harvest units as described in the Forest Plan standards FW – 349 and FW – 353.The shelterwood alternative would thin from below with a variable density and intermediate thinning on approximately 5,076 acres and shelterwood approximately 284 acres. The areas under this alternative that are proposed to be treated with a VDT and intermediate thin will have the same effects described under the proposed action alternative.

Areas treated with a shelterwood treatment would be moved from mostly dense closed canopy mature multi-storied stand conditions to stand initiation early successional conditions. Stand conditions would be more open in both the moist mix conifer and dry mix conifer plant associations. These conditions would have low canopy cover with openings large enough to stimulate natural regeneration of shade intolerant tree and shrub species within these types of plant associations. Species diversity in the overstory, seedling, sapling, and shrub layers is essential to the two dominant plant associations within the shelterwood treatment areas. However, in the short-term, overstory species diversity would remain limited. Over time as a diversity of species regenerate and became established, the overstory diversity would increase.

Overall the shelterwood treatment areas QMD would fluctuates over time from 22.1 inches DBH at the completion of harvest to 9.2 inches DBH 100 years after harvest. This is indicative of stands that have regeneration occurring through time. Stands QMD is fluctuating to reflect the ingrowth of smaller diameter trees that begin to contribute to the stand BA. The stands TPA and BA also continue to increase, indicative of stands with multiple regeneration cohorts or events. Also SDI increases over time from 117 immediately after treatment to 328. These density measurement indicators are used for evaluating stand health and productivity over time. The density metrics shown below (reference Table 18, Table 19, Table 20, and Table 20 and Figure 9) Figure 9. Projected structure 100 years after shelterwood treatment is applied for stands currently in the stem exclusion stage.can be used to evaluate the stand's vulnerability to large scale insect disturbances. In the short term within the shelterwood treatments, stand densities and species composition would create defensible space and create more early seral habitat conditions within the watershed. To maintain this defensible space and keep the stands on a more open trajectory a re-entry thin or other density management activities would be expected every 50-60 years dependent on site conditions.

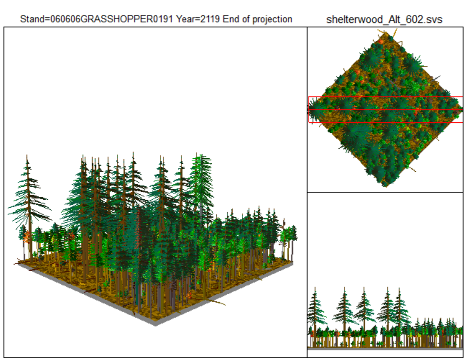

Figure 9. Projected structure 100 years after shelterwood treatment is applied for stands currently in the stem exclusion stage.

Table 18. Resulting density levels in stands currently in the stem exclusion stage from FVS modeling of the shelterwood alternative

Time After Treatment	Basal Area (BA)	Trees per Acre (TPA)	Quadratic Mean Diameter	Average Stand Height (feet)
2019	60	23	21.9	74
2069	116	569	6.1	60
2119	228	564	8.6	69

Table 19. Resource indicators and measures of effects on residual tree, insect, and disease processes. Modeling is based on a representative sample of plantations and non-plantations thinning units. (Refer to project record for a complete list of units).

Time After Treatment	Existing BA	Proposed Action BA	Existing TPA	Proposed Action TPA	Existing QMD	Proposed Action QMD	Existing Average Stand Height (feet)	Proposed Action Average Stand Height (feet)
2019	175	85	361	60	10.4	22.1	83	87
2069	174	127	450	479	8.3	7.1	89	67
2119	166	172	549	397	7.4	9.2	86	68

Table 20. Resource indicators and measures for forest structure and composition after treatment.

Structural Stage	Existing Condition Percent of the Planning Area	Effect of Shelterwood Alternative Percent of the Planning Area
Stand Initiation	15%	40%
Stem Exclusion	19%	5%
Understory Reinitiation	43%	37%
Mature Stem Exclusion	15%	5%
Late Seral Multistory Closed	2%	2%
Late Seral Open	0%	6%
Non-Forested	5%	5%

3.2.4 - Cumulative Effects

Discussions of the cumulative effects are limited to those past, present and reasonably foreseeable activities that have been determined to have a cumulative effect on the vegetative resource. This section covers the cumulative effects for both Alternatives 1 and 2. The interdisciplinary team listed projects and activities that should be considered in the cumulative effects analysis. This information is included in the project record. The table below shows activities that were considered in this cumulative effects analysis for vegetative conditions. Only activities proposed in the Grasshopper Restoration project that modify stand structural characteristics have direct or indirect effects on the vegetative resource and are included in the cumulative effects analysis. The spatial context for the following cumulative effects analysis is White River Watershed (the landscape scale) and the project area (site-specific scale) as described previously in the existing conditions. The temporal context depends on the past, existing or future projects/activities – if there is an overlap in time from an effects perspective then it is included. Only activities which have the potential to modify stand structural characteristics (direct/indirect effects) would have the potential to contribute to cumulative effects. These stand characteristics may include species distribution, vertical or horizontal spatial patterns, tree size distribution, age distribution, or any combination thereof.

3.2.4.1 Cumulative Effects at the Landscape Scale

The existing vegetative condition at the landscape scale as described in the existing condition section of this report is a direct reflection of all previous activities and serves as the baseline for the effects determination. This includes all activities listed in the past activity and ongoing activity portions of Table 21 including the impacts of the 2020 White River wildfire. As such all the effects from previous and ongoing activities including those listed in Table 21 are inherently incorporated into the existing condition of this analysis. Timbered stands within this landbase are managed for a variety of reasons from wildlife habitat to timber production. It is anticipated that management and harvest on the lands on and off federal lands would continue at previously observed. Due to these activities the overall watershed vegetative condition are anticipated to remain relatively consistent throughout time and will not cumulatively alter the overall stand composition of the watershed beyond the current existing condition.

3.2.4.2 Cumulative Effects at the Site-specific Scale

The existing vegetative condition at the stand and project area level as described in the existing condition section of this report are a direct reflection of all previous activities and serve as the baseline for the effects determination and include all activities listed in the past activity and ongoing activity portions of Table 21. As such all the effects from previous activities including those listed in Table 21 are inherently incorporated into existing condition of this analysis. In reviewing the activities listed in Table 21 there are no other ongoing, or future proposed activities at the stand or project area level which would impact the vegetative resource at this scale. As such there are no direct or indirect effects to consider cumulatively beyond those directly associated with proposed activities.

Table 21. List of Projects Considered in Cumulative Effects Analysis

Past Activities	Modify Stand Structure	Effects Overlap In Time	Effects Overlap in Space	Captured in Existing Condition	Cumulative Effect Potential
Instream Restoration	No	N/A	N/A	N/A	N/A
Past timber harvests on Mt. Hood National Forest System (NFS) lands and adjacent lands under other ownership	Yes	Yes	Yes	Yes	N/A
Road Decommissioning and Road Closures	No	N/A	N/A	N/A	N/A
White River Fire (2020)	Yes	Yes	Yes	Yes	N/A
Ongoing Activities					
Right-of-way maintenance, including herbicide treatments	No	N/A	N/A	N/A	N/A
Maintenance of irrigation district Infrastructure	No	N/A	N/A	N/A	N/A
Timber sale activity on Mt. Hood NFS lands*	Yes	Yes	Yes	Yes	N/A
Timber Sales, including activity fuels reduction (burning) on adjacent land ownerships	Yes	Yes	Yes	Yes	N/A
Firewood and Special Forest Products	No	N/A	N/A	N/A	N/A
Instream Restoration	No	N/A	N/A	N/A	N/A
Pre-commercial thinning	Yes	Yes	Yes	Yes	N/A
Recreational Use	No	N/A	N/A	N/A	N/A
Site-Specific Noxious Weed Treatments	No	N/A	N/A	N/A	N/A
Irrigation District facilities maintenance and operations	No	N/A	N/A	N/A	N/A
Rock Crushing in quarry and rock haul	No	N/A	N/A	N/A	N/A
Road construction on adjacent land ownerships	No	N/A	N/A	N/A	N/A
Future Activities					
Timber harvest related activities (road construction and log haul)	Yes	Yes	Yes	No	Yes

*Timber sale activities include salvage and roadside danger tree abatement sales occurring in the White River Wildfire.

3.2.5 - Degree to Which the Purpose and Need for Action is Met

This report has described how the action alternatives meet the purpose and need element of the Grasshopper project described as “to enhance and restore forest diversity, structure, and species composition…”. Two other components of the purpose and need in the Grasshopper project area are a need to reduce risk associated with high intensity wildfire for both the public and firefighter safety and to provide forest products to help maintain the stability of local and regional economics. Refer to Table 22 for a comparison of how the alternatives address these elements of the purpose and need. For a complete description of effects related to wildland fire refer to the Fuels Report which is incorporated by reference and included on the project website.

Table 22. Summary comparison of how the alternatives address other purpose and need elements

Purpose and Need Element	Indicator/Measure	Existing Condition	Proposed Action	Shelterwood Alternative
Open Defensible Space	Percent of the Project area in Stand Initiation Structure	15%	20%	40%
	Percent of the Project area in either Stem or Mature Stem Exclusion Structure	34%	15%	10%
Forest Products	Estimated Volume (MMBF)	0	19.8	21.4

3.3 - Consistency with Management Direction

3.3.1 NFMA Findings for Vegetation Manipulation

As required by regulations (FSH 1909.12 5.31a), "all proposals that involve vegetative manipulation of tree cover for any purpose must comply with the seven requirements found at 36 CFR 219.27(b)." All of these requirements are met by the project (refer to project record).

As a pre-cursor to the silvicultural diagnosis process, stand examinations are conducted to determine existing stand conditions, and a determination of suitability (in regard to management of the stand for timber production) is made for each stand. Stands proposed for harvest treatment were examined for suitability in accordance with 36 CFR 219.13, Timber resource land suitability. Stands were found to be suitable for timber management based upon the following:

- Meet the definition of forest land as described in 36 CFR 219.19;
- Technological feasibility exists to ensure soil productivity and watershed protection. All sites considered for treatment would use established harvesting and site preparation methods. In combination with resource protection standards in the Forest Plan and applicable Best Management Practices, these methods would be sufficient to protect soil and water resource values;
- There is reasonable assurance that lands could be restocked within 5 years of final harvest.

Finding: As described above within this report, all silvicultural activities would be implemented only on lands meeting the definition of forest land (16 U.S.C. 1604) and designated as suitable for timber production by the Forest Plan (USDA Forest Service 1990), as amended.

3.3.2 Special Roadless Area Conservation Rule of 2001: Inventoried Roadless Areas

All proposed treatments within Inventoried Roadless Areas (IRA) would be consistent with the Roadless Area Conservation Rule (RACR) exception §294.13(b)1(ii). Approval for this exception was received from the Deputy Regional Forester in 2019. Treatments would take place on approximately 272 acres of Inventory Roadless Area (IRA). The cutting and removal of generally small diameter timber would occur to improve ecosystem composition, stand structure, and reduce risk of uncharacteristic wildfire.

Findings: Both alternatives propose thinning of less than 14 inch diameter material within IRA to open the stands and reduce stocking levels. These conditions would create more healthy growing conditions for the residual trees while providing growing space for more fire tolerant trees species to establish. More open stand conditions will allow for the reintroduction of low intensity fire as the major disturbance regime while also mitigating risk of a large scale stand replacing event.

3.3.3 2009 Omnibus Public Law 111-11: National Recreation Areas

Per the Omnibus Law, management actions within the Mt. Hood National Recreation Area (NRA) would not degrade the protection, preservation, and enhancement of recreational ecological, scenic, cultural, watershed, and fish and wildlife values of the area.

Findings: Both alternatives include thinning activities within the NRA that would focus on moving existing stands of timber towards more historic species composition and structural conditions by opening the stand and reducing stocking levels. These activities would create healthy growing conditions for current residual trees while providing growing space for shade intolerant species and additional age classes to establish. Restoration of stand composition and structure for ecosystem and forest health is permitted within the NRA.

3.3.4 Mt. Hood Land and Resource Management Plan (Forest Plan)

3.3.4.1 Suitability for even-aged and uneven-aged management

Forest Plan guidelines advise against uneven aged management in stands with dwarf mistletoe and/or root disease. Even-aged management is the effective way to manage dwarf mistletoe and root disease. (Forestwide Standards (FW) 316 and 317), (C1-019-021) and (C1-024). Created openings should be no more than 2 acres for the purposes of uneven-age management (FW 323 and 324) and should be focused in areas of stands that are diseased, infested with damaging insect populations, or damaged by storms (C1-022).

3.3.4.1 Suitability for Regeneration Harvest

Forest openings created by even-age harvest methods should not exceed 60 acres (FW-349-350). Created openings shall be separated by blocks of land that are not classed as created openings (FW-351-353). Timber stands should not be regeneration harvested until they have reached or surpassed 95% of culmination of mean annual increment (CMAI) measured in cubic feet. Exceptions may be made where resource management objectives or special resource consideration require earlier harvest (FW-306 and 307). Stands currently proposed for regeneration harvest have culminated.

3.3.4.3. Suitability for reforestation
Forest plan guidelines advise timber harvesting shall be completed in a fashion that reasonably assures each harvest area can be adequately restocked within 5 years after final harvest (FW-358). Replanting would occur to a minimum of 125 trees per acre (FW361-363) in root rot openings large enough to support resistant tree species establishment. Interplanting would be used to maintain genetic quality and desired species composition (FW-332). The proposed treatments would be consistent with all of the above mentioned standards for reforestation

Finding: The proposed treatments would be consistent with all of the above mentioned standards with mandatory reforestation within Shelterwood treatments.

3.4 – Summary of Effects

Moist Mix Conifer Plant Communities:

For both action alternatives, moist mix conifer stands desired conditions after treatment would be open early seral structure with defensible space. Pushing stands toward the desired future conditions would create or maintain both open and closed multi-storied and uneven-aged stand conditions in the moist mixed conifer communities at a landscape scale while creating early seral habitat at the stand scale. Monitoring would occur throughout the next generation to determine the stands' response to thinning and evaluate if re-entry thinning and burning is needed to create or maintain the desired future conditions

Dry Mix Conifer Plant Communities:

For both action alternatives, the dry mix conifer stands would move towards a late seral multi-aged open forest structure and a properly functioning plant community as defined by the Northwest Forest Plan and the Mt Hood Land Management and Resource Plan (LRMP). Dry mix conifer stands would be transitioned towards open two-storied stands. Post treatment, the stands will become more resilient to stand replacing disturbance such as insect attack, disease, and high intensity wildland fire. This would require a reduction in total stand density. Within these dry mix conifer stands the goal is to create a stand structure that allows the efficient reintroduction of natural fire. In the long term this would allow fire to resume its natural processes and be easily managed. Monitoring would occur throughout the next generation to determine the stands' response to thinning and evaluate if re-entry thinning and burning is needed to create or maintain the desired future conditions.

Table 23 and Table 24**Table 24** compare the effects of taking no action with the proposed action and shelterwood alternative. Compared to taking no action, both the proposed action and shelterwood alternative would lower the TPA and BA while still increasing stand QMD and height in the immediate term. This would open the canopy allowing for additional growing space in the understory productivity. In larger openings there would be increased regeneration of shade intolerant tree species. This would ultimately allow for a new age class of trees to become established increasing the distribution of multi-aged stands within the project area. Over time higher densities would occur in the treatment areas as this new age class develops reducing the QMD in the proposed action over the no action alternative. Lower TPA and BA would also result in stands that would be less vulnerable to large insect and disease outbreaks, due to less competition and stress related mortality. The shelterwood alternative would provide additional early successional habitat or stand initiation structural stage then both the proposed action and no action alternatives. This structural stage would provide for a more landscape diversity of species composition and structure while also providing defensible space during a large scale event.

Table 23. Summary Comparison of Density measurement indicators after treatment

Density Measurement	No Action	Proposed Action	Shelterwood Alternative
Basal Area (BA)	175	93	85
Trees per Acre (TPA)	361	80	60
Quadratic Mean Diameter (QMD)	10.4	21.0	22.1
Stand Density Index (SDI)	319	133	118
Average Tree Height	83	86	87

Table 24. Summary Comparison of Stand Structural Stages After Treatment

Structural Stage	Existing Condition Percent of the Planning Area	Effect of Proposed Action Alternative Percent of the Planning Area	Effect of Shelterwood Alternative Percent of the Planning Area
Stand Initiation	15%	20%	40%
Stem Exclusion	19%	5%	5%
Understory Reinitiation	43%	50%	37%
Mature Stem Exclusion	15%	10%	5%
Late Seral Multistory	2%	2%	2%
Late Seral Open	0%	8%	6%
Non-Forested	5%	5%	5%

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