

Cliff Knox Project

Silviculture Report

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for:
Prairie City Ranger District
Malheur National Forest

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Introduction

The following discussion assumes that all the project design criteria for the action alternatives are carried out as described in the Cliff Knox Project Final Environmental Impact Statement, chapter 2, and Appendix C – Project Design Criteria. Details of these actions can be found in the silvicultural prescription. The silvicultural aspects and implications to the affected environment and environmental consequences of the treatments will be covered.

Summary of Effects

Stand density, structure and forest products and jobs would continue its current trajectory if no action (alternative 1) occurs in the Cliff Knox planning area. Stand densities would continue to increase so much of the planning area would be highly susceptible to uncharacteristically severe wildfire and continued epidemic insect outbreaks. Over time, the planning area would become deficient in young forest and have an abundance of stem exclusion forest structure. Late seral species would continue to increase in abundance due to natural regeneration and competition-induced mortality of early seral species. Other plant communities such as aspen and mountain mahogany would continue to decline in health and extent as conifers continue to encroach.

In alternative 2, stand densities and structure would be altered across much of the planning area. Silvicultural treatments would reduce stand density and the effects of density reduction would continue at least 30 years in the future. This would reduce the risk of a large uncharacteristically severe wildfire and continued insect activity. Over time, old forest would increase when compared to alternative one, but stem exclusion and young forest would also increase in some areas. Old forest structures would also move within the historical range of variability over time and the planning area would have more open dry pine stands. Treatments would provide forest products and jobs in the local area. Alternative 3 would produce similar effects to alternative 2, but at a smaller scale as it treats fewer acres. Treatments in other plant communities such as aspen and mountain mahogany would have encroaching conifers removed or reduced, allowing those plant communities to move toward a more historical extent.

Cumulatively, alternatives 2 and 3, and other recent National Environmental Policy Act projects would be widespread, and effectively reduce the risk of large-scale uncharacteristically severe wildfire and epidemic insect outbreak in all forest structural stages in all plant association groups across the treated areas of the Cliff Knox planning area. The actions within the Cliff Knox, Wolf, Summit, Elk 16, Knox, Central Malheur River, and Aquatic Restoration projects would thin approximately 40 percent and prescribe burn approximately 70 percent of the area within the cumulative effects boundary over a 25-year period of time for alternative 2. For alternative 3, the actions would thin approximately 35 percent of the area, and prescribed burn approximately 55 percent of the cumulative effect's boundary over a 25-year period.

Table 1. Comparison of alternatives by treatment

Action	Alternative 1 (no action)	Alternative 2 acres	Alternative 3 acres
Commercial thinning (small diameter)	0	18,700 – commercial 4,360 – small diameter only 23,060 – total	16,580 – commercial 6,200 – small diameter only 22,780 – total
Non-commercial thinning	0	4,280	3,650

Table 2. Comparison of alternatives by Late and Old Structure

Late and Old Structure (LOS)	Alternative 1 (no action)	Alternative 2	Alternative 3	Hot Dry (HD) HRV percent	Warm Dry (WD) HRV percent
OFMS post-harvest	Project wide 28% HD 50% WD 31%	Project wide 15% HD 21% WD 14%	Project wide 15% HD 21% WD 14%	5-15%	5-20%
OFSS post-harvest	Project wide 3% HD 8% WD 4%	Project wide 23% HD 43% WD 20%	Project wide 22% HD 43% WD 19%	20-70%	15-55%
OFMS after 40 years	Project wide 55% HD 75% WD 53%	Project wide 23% HD 27% WD 24%	Project wide 25% HD 26% WD 25%	5-15%	5-20%
OFSS after 40 years	Project wide 13% HD 14% WD 13%	Project wide 32% HD 61% WD 28%	Project wide 30% HD 62% WD 26%	20-70%	15-55%

OFMS – old forest multi-strata

OFSS – old forest single stratum

HRV – historical range of variability

Table 3. Comparison of alternatives by stocking level post-harvest

Stocking level post-harvest	Alternative 1 (no action)	Alternative 2	Alternative 3
Below management zone	Hot Dry <1% Warm Dry 1%	Hot Dry 29% Warm Dry 47%	Hot Dry 29% Warm Dry 46%
Within management zone	Hot Dry 6% Warm Dry 5%	Hot Dry 12% Warm Dry 20%	Hot Dry 12% Warm Dry 20%
Above management zone	Hot Dry 94% Warm Dry 94%	Hot Dry 59% Warm Dry 33%	Hot Dry 59% Warm Dry 34%

Table 4. Comparison of alternatives by stocking level in 40 years

Stocking level in 40 years	Alternative 1 (no action)	Alternative 2	Alternative 3
Below management zone	Hot Dry 0% Warm Dry 0%	Hot Dry 22% Warm Dry 32%	Hot Dry 21% Warm Dry 30%
Within management zone	Hot Dry <1% Warm Dry 2%	Hot Dry 8% Warm Dry 21%	Hot Dry 11% Warm Dry 22%
Above management zone	Hot Dry 100% Warm Dry 98%	Hot Dry 70% Warm Dry 47%	Hot Dry 68% Warm Dry 48%

Regulatory Framework

Malheur Forest Plan

Management direction established in the Malheur National Forest Land and Resource Management Plan (hereafter Malheur Forest Plan, USDA Forest Service 1990) direct proposed activities. The Malheur Forest Plan details management goals and objectives, along with specific management area standards are detailed in the Malheur Forest Plan. The Malheur Forest Plan provides standards and guidelines for forest vegetation.

Timber harvest, reforestation, and stand improvement (Malheur Forest Plan, pages IV–36 – 39):

- Based on site-specific silvicultural prescriptions, apply even-aged or uneven-aged management systems to forest timber stands. Determine the applicable management system for any timber stand using specific management area direction and project level environmental analysis.
- Manage to maintain or re-establish ponderosa pine, at time of regeneration, on sites where ponderosa pine is sub-climax.
- Schedule and implement precommercial thinning to achieve desired stocking level based on a site-specific silvicultural examination and interdisciplinary prescription.

Insects and Disease (Malheur Forest Plan, page IV–45):

- Apply integrated pest management principles to minimize the impacts of the mountain pine beetle, western spruce budworm, tussock moth and other insect and disease infestations.
- Avoid the creation of vegetation conditions that could promote insect and disease infestations.

Aspen (Malheur Forest Plan, pages IV–31, IV–56):

The Malheur Forest Plan standards and goals relevant to the desired condition for aspen and other hardwoods and shrubs include:

- Maintain or enhance quaking aspen stands using overstory removal and prescribed fire as principal means of regeneration where appropriate. Protect root sprouts where needed and practical.
- Manage the composition and productivity of key riparian vegetation to protect or enhance riparian-dependent resources. Emphasis would be on the reestablishment of remnant shrub and tree communities.

Regional Forester's Forest Plan Amendment 2 (Eastside Screens)

Additional management direction has been provided by forest plan amendments approved since 1990, such as “Interim Management Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales”, also known as Regional Forester’s Eastside Forest Plan Amendment 2 – Eastside Screens (USDA Forest Service 1995).

All timber sales would be designed to incorporate the interim riparian, ecosystem and wildlife standards as set forth in the Regional Forester’s Eastside Forest Plan Amendment 2. These standards supersede previous Forest Plan and other management guidelines.

National Forest Management Act

The National Forest Management Act provides standards and policies regulating timber harvest.

Resource Indicators and Measures for Assessing Effects

The analysis indicators for assessing effects of each alternative and for comparing alternatives include historical range of variability as defined by structural stages across the landscape, stand density, and the extent to which treatments in the area achieve these objectives and provide for the accelerated restoration strategy of treating more acres and providing forest restoration jobs. See Existing Condition section below for description of indicators and methods used to measure them.

Table 5. Resource indicators and measures for assessing effects to forest vegetation

Resource Indicator	Measure	Source
Structural stages to be within, or moving towards the historical range of variability	Percentage change of structural stages in relation to historical range of variability	Regional Forester's Eastside Forest Plan Amendment 2 (USDA Forest Service 1995, Powell 2012)
Stand density across the planning area	Percentage change of acres above the management zone, within the management zone, and below the management zone as defined by maximum stand density index	Suggested stocking levels for forest stands in Northeastern Oregon and Southeastern Washington: an implementation guide for the Umatilla National Forest (Powell 1998)
Wood products and forest restoration jobs provided	Acres mechanically treated	Malheur Forest Plan (USDA Forest Service 1990)

Affected Environment

The Cliff Knox Project is located in the southwestern area of the Prairie City Ranger District and the northeastern area of the Emigrant Creek Ranger District. The Malheur River physically splits the project area. Cliff Knox planning area is approximately 40,300 acres in size, with about 34,000 forested acres. Approximately 6,100 acres are non-forested, and 420 acres are non-vegetated (such as rock or water) or unknown vegetation.

The overarching purpose and need for the project is to restore stand resilience to drought, insect and disease outbreaks, and uncharacteristic wildfires by moving stands toward a more historical range of variability for structure, density, and species composition, and to reestablish historical openings and grasslands where encroaching juniper and other conifers have invaded where they did not historically occur. This resilient landscape can be characterized by stand densities allowing for good growth and maintenance of healthy stand, by stand structures within the range of historical variability, and by predominantly early seral species composition. Obtaining the desired conditions would increase tree growth and vigor, decrease risk of uncharacteristically severe wildfire, and promote resiliency and resistance of the overstory component to insect and disease outbreaks. Forest Service Vegetation Spatial Data Analyzer (hereafter FSveg Spatial Data Analyzer) was used to model the alternatives discussed in this report. It was used to compare the probable outcomes of the alternatives. The Malheur National Forest Land and Management Plan (Malheur Forest Plan 1990) including amendments provides the standards and guidelines for the project. In areas where new science exists to assist with forest management, those documents are cited. Blue Mountain Forest Partner zones of agreement are used, as “best available science” was used to build those documents.

Historical Condition

Settlement in northern Harney County and southern Grant County started in the late 1800s. While early homesteaders moved into the Seneca Valley area and south in the 1890s, the area really began growing when in 1929, the area became the terminus of the Northwestern Railroad, owned by Edward Hines Lumber Company, which extended south to Burns, Oregon.

Approximately 34,100 acres of the 40,300-acre planning area were included in the original Forest Reserve in 1906. In 1907 the Organic Act added approximately 1,900 acres within the planning area to the original Reserve acres. Between 1946 and 1949, another 4,230 acres within the planning area were added to the Malheur National Forest in an exchange with Edward Hines Lumber Company (GIS R6 Reference Library Geodatabase 2019). All the acres added to the original Forest Reserve were forested acres.

Historically, many of the large overstory ponderosa pine and western larch were removed. Other tree species harvested included Douglas-fir, grand fir and lodgepole pine. Harvest activities by the Forest Service over the last 35 years have shown various harvest activities over approximately 20,900 acres within the planning area. Plantations exist where activities occurred prior to Forest Service recorded activities. Two large projects near the area include a portion of the Malheur River Project in the late 1920s, and the Bear Valley Timber Sale sold in 1923 (estimated 890,000 million board feet; 770,000 of which were ponderosa pine), which was located in areas just outside of the Cliff Knox planning area.

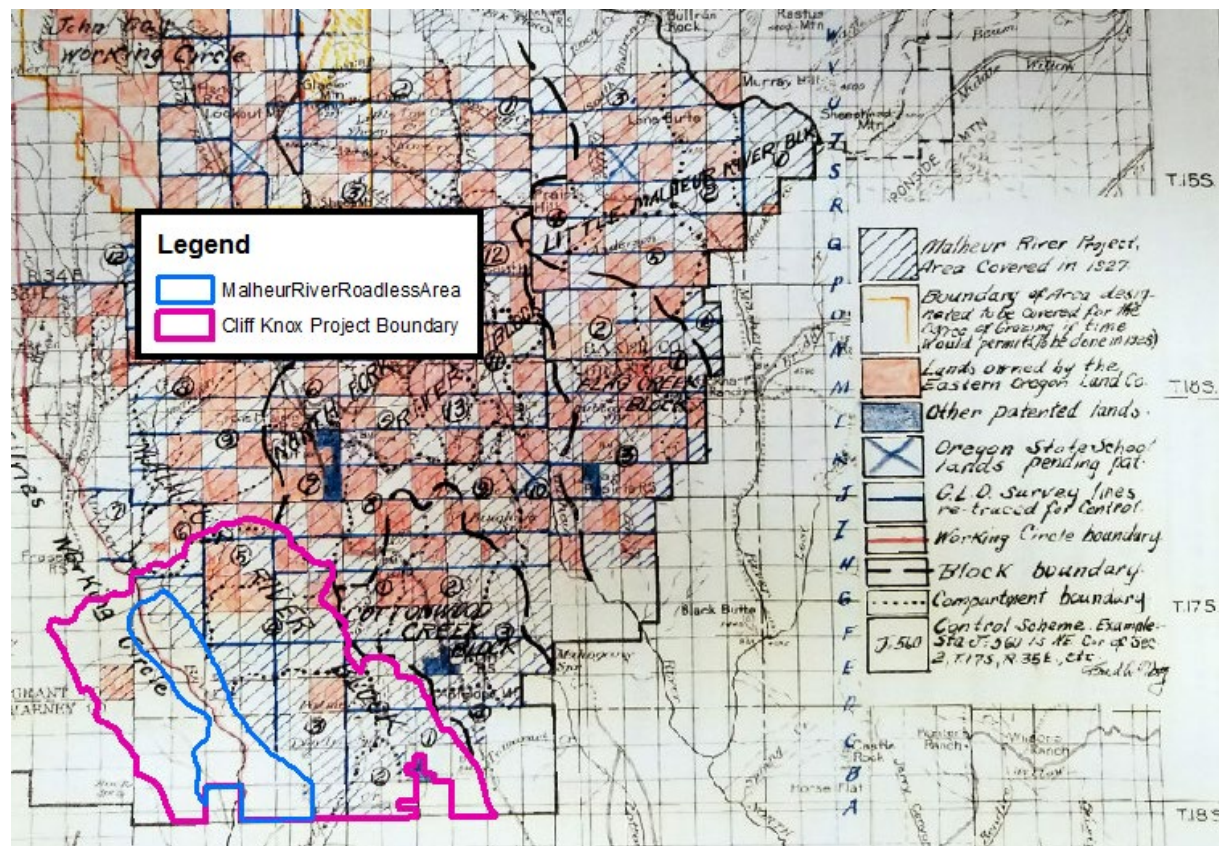


Figure 1. Map of ownership from January 1931 timber surveys, Malheur River Project

Fire History

Between 1960 and 2019, there have been 119 recorded fire starts suppressed within the Cliff Knox planning area, 95 percent of which have been kept under 10 acres in size. One fire in the area exceeded 100 acres, but suppression activities controlled the largest fire before it reached 400 acres. Average fire occurrence in the area is two to three per year. Historically, fire starts occurred evenly across the planning area. Extrapolating these numbers across the last 100 years (estimated time of settlement) approximately 200 fires may have occurred and been suppressed.

Suppression activity allowed a change in vegetation. Encroachment of conifers into meadow areas and encroachment of later seral species have grown into areas previously defined by open ponderosa pine stands has occurred in Hot Dry and Warm Dry plant association groups. Historically, fire acted as the dominant disturbance on the landscape due to Native American burning and lightning strikes during thunderstorms. The Warm Dry and Hot Dry forests within the planning area are classified as fire regime 1 (Schmidt et al. 2002). This fire regime included frequent (0 to 35-year return interval), low-severity fires. The extent of these frequent ground fires likely varied from small areas (less than 10 acres in size) to

entire slopes covering thousands of acres depending upon the season, topography, and climatic conditions. These fires were agents of stability, favoring fire-resistant species (ponderosa pine, western larch, and to a lesser extent Douglas-fir) and development of more open, park-like stands with little vertical structure. They also kept the ground vegetation dominated by fire-adapted grasses such as pine grass and elk sedge. Shade-tolerant species (grand fir and Douglas-fir) were generally susceptible to these fires due to their thinner bark when young, and persistent, low-hanging crown characteristics.

Fire intensity also varied in response to vegetative conditions. Small areas of denser forest patches occurred in areas missed or more resistant to fire (draws, spring seep areas, and northerly aspects). Areas missed by frequent fires developed conditions where subsequent fires could potentially be of moderate to high intensity, resulting in stand-replacement patches.



Figure 2. Example of encroaching understory with large ponderosa pine overstory.



Figure 3. Small fire exhibiting creeping action through the understory.

The frequent, low-severity fires in this area have been suppressed with current fire policies. Early timber harvest and fire suppression cumulatively have changed stand conditions within the planning area, allowing for the build-up of surface fuels, increases in stand density, and ingrowth of late seral species creating ladder fuels. This has changed the fire regime in the dominant forest types to less frequent, mixed severity and high severity events with larger stand-replacement patch sizes. Fires in areas of similar stand conditions escaping initial attack include the Canyon Creek fire of 2015 (approximately 130,000 acres), Parrish Cabin fire of 2012 (approximately 6,000 acres), Jordan Springs fire of 1994 (approximately 5,780 acres), Bear Canyon fire of 2007 (approximately 52,800 acres), Pine Springs fire of 1990 (approximately 71,820 acres), and the Egley Fire of 2007 (approximately 55,420 acres). It was noticed that fire activity of the Canyon Creek fire dropped out of the canopy when it reached the perimeter of the Parrish Cabin fire. It was also noted that activity areas left in dense wildlife “skip” patches showed high severity burn patterns. All of these large fires had areas of high severity burn.

Existing Condition

A total of six upland forest plant association groups occur within the planning area as displayed in Table 6 following.

Table 6. Plant association groups within Cliff Knox planning area

Plant Association Group	Acres**	Percent of Total area
Warm Dry Upland Forest*	27,993	70
Hot Dry Upland Forest*	4,269	10
Hot Moist Upland Woodland	779	2
Cool Dry Upland Forest	444	1
Warm Moist Upland Shrub	242	<1

Plant Association Group	Acres**	Percent of Total area
Hot Dry Upland Woodland	162	<1
Cold Dry Upland Forest	156	<1
Warm Moist Upland Forest	116	<1
Hot Moist Upland Forest	30	<1
Non-forest	6,066	15
Total acres	40,258	

*10-25-year fire return average (Johnston et al. 2017).

**Acres from the Forest Vegetation Simulator are not exact to project acres as Forest Vegetation Simulator uses whole stand acres. The planning area boundary may split some stands. However, percentage of plant association groups would be consistent for the planning area

As the planning area is greater than 15,000 acres, it is an appropriate size to conduct an analysis of historical range of variability (Powell 2012). According to Powell, it is not appropriate to conduct a historical range of variability analysis for a plant association group within the planning area if it is less than 1,000 acres, because a full complement of cover types, structural stages, or tree density classes would not be expected in small areas. Therefore, two plant association groups – Hot Dry Upland Forest (4,270 acres) and Warm Dry Upland Forest (27,990 acres) were analyzed for historical range of variability based on structure stages.

Hot Dry and Warm Dry Upland Forests occupy approximately 80 percent of the planning area, and 98 percent of the upland forested acres. These areas were historically less dense than today's forests, dominated by ponderosa pine and western larch, and tended to have a single canopy layer. The Malheur River flows in a mostly north to south direction, with a small number of tributaries coming into the Malheur River from the east and west. Most of the planning area has an east, south, or west aspect, with only a small portion having a northern aspect.

Non-forested lands make up approximately 6,100 acres, or about 15 percent of the total acres within the Cliff Knox planning area. While these areas of upland herb exist within the project area, the model does not include herbaceous plant association calculations, and they are not assessed as part of the Silvicultural analysis.

All structural stages are represented within the Cliff Knox planning area. Late and old structure includes old forest single stratum and old forest multi-strata. Currently, approximately 31 percent of the planning area is late and old structure. The vast majority of existing late and old structure occurs in the old forest multi-strata structure type. Old forest multi-strata and young forest multi-strata are the highest represented stand structures, thus over half of the upland forested area in the Cliff Knox planning area is currently closed canopy forest.

Table 7. Structural stages within the Cliff Knox planning area

Structure type	Acres	Percent
Old forest single stratum	1,131	3%
Old forest multi-strata	9,098	28%
Young forest multi-strata	8,218	25%
Stem exclusion open canopy	4,216	13%
Stem exclusion closed canopy	4,491	14%
Understory reinitiation	4,827	15%
Stand initiation	593	2%

Designated or replacement old growth (management area 13) make up approximately 2,100 acres, or 5 percent of the Cliff Knox planning area. Only 3 percent of the designated and replacement old growth falls within or below desired stocking levels for healthy forest stands. Ninety-seven percent is considered above the management zone for healthy stands. Approximately 98 percent of the designated and replacement old growth occur in Hot Dry Upland Forest and Warm Dry Upland Forest plant association groups.

The main tree species occurring within the Cliff Knox planning area include ponderosa pine, Douglas-fir, western larch, grand fir, and lodgepole pine. Western white pine occurs in a small area in the northeast portion of the project area. Aspen also occurs in riparian and upland forest areas. The Cliff Knox planning area is located in an area of transition between forest, and sagebrush and grasslands. Western juniper occurs in more open areas and in upland woodlands, accounting for approximately 940 acres. In these areas, the current stocking level is above the management zone for healthy stands.

Approximately 1,440 acres of the planning area falls within designated riparian habitat conservation area of category 1 (fish-bearing) streams. Approximately 240 acres occur within category 2 (perennial flowing stream) riparian habitat conservation area, and approximately 1,200 acres of riparian habitat conservation area included in areas of category 4 (intermittent) streams. Approximately 15 percent of the planning area is non-forested. This includes areas of open meadows or sagebrush flats (shrub-steppe) and occurs primarily in the southern transition area between dry forests and high desert vegetation.

Stand density index is a common measure of density that allows comparisons across units independent of individual tree age and size (Powell 1999). For any given average tree size for each species there is a limit to the number of trees per acre that may coexist in a stand. This limit is known as the maximum stand density index. The percent of maximum stand density index is an index of intra-tree competition for site resources and is an indication of overall stand health, including tree growth and mortality, susceptibility to mortality from insects and diseases, and fire hazard. Percent maximum stand density index is generally divided into categories that define tree growth, stand growth, and mortality. Below the management zone (0 to 35 percent maximum stand density index), there may be natural regeneration and there is generally high individual tree growth within the stand. The management zone (35 to 60 percent maximum stand density index) is where silviculturists tend to prescribe to manage within, because tree growth and stand growth capture maximum resources. Above the management zone (greater than 60 percent maximum stand density index), competition-induced mortality begins to occur. As density increases above the management zone, generally high mortality occurs and stands stagnate. As stands grow above the management zone, susceptibility to insect infestation and uncharacteristically severe wildfire increases. Currently, 28,300 acres within the Cliff Knox planning area exist above the upper management zone as it relates to stand density index. About 3,850 acres exist within the management zone, and approximately 820 acres exist below the management zone. Within the planning area, there are approximately 950 acres of upland woodland where conifers have encroached. While considered woodland, it has enough conifers to model as above the management zone for forested lands.

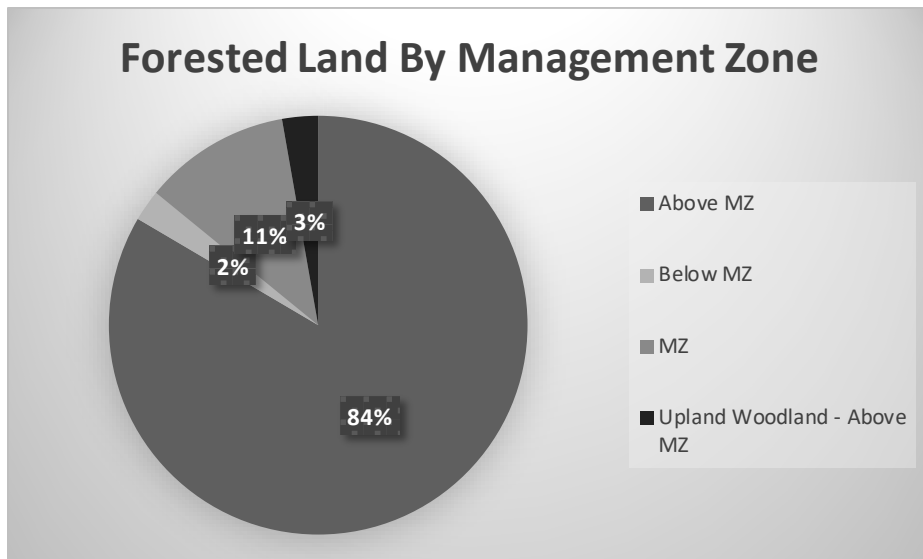


Figure 4. Percent of areas considered above healthy management zone, using stand density index

The ingrowth of late seral species and increased stand densities have created conditions promoting insect outbreaks. Pine butterfly outbreaks occurred in 2011 and 2012. This was followed by multiple years of drought. Areas within the Warm Dry and Hot Dry vegetation types have large, older ponderosa pine within the stand. Many large ponderosa pine trees have not recovered a full complement of foliage following defoliation during the recent outbreak of pine butterfly and have subsequently died from attacks from western pine beetle and mountain pine beetle. Stand density is often greater than the lower level of the self-thinning zone (this is the area within stand density index above the upper limit of the management zone) even in areas previously thinned (Johnson and McWilliams 2016) and could lead to decreased vigor, less resiliency and lower resistance of stand to mortality agents.

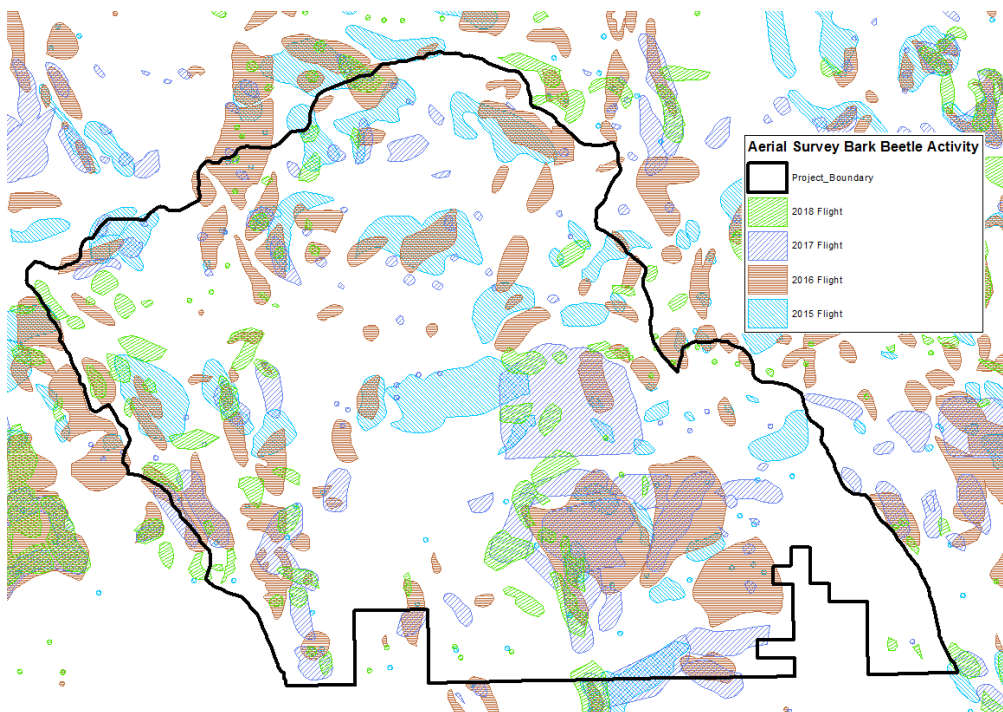


Figure 5. Bark beetle activity in the planning area as observed in the past 4-year aerial surveys (current as of 05/06/2020)

Hot Dry Plant Association Group

The Hot Dry plant association group includes mostly ponderosa pine plant associations. Ground vegetation generally consists of pine grass, elk sedge, Idaho fescue, bluebunch wheatgrass, mountain big sagebrush, mountain mahogany, common snowberry, bitterbrush and birchleaf spirea. Within the Hot Dry plant association group, stem exclusion closed canopy stands are not represented (this falls within the historical range of variability of 0-5 percent). All other stand structures occur within the Hot Dry plant association group. Late and old structure stands (includes old forest multi-strata and old forest single stratum) make up approximately 58 percent of the Hot Dry plant association group. Currently old forest multi-strata stands occur at a higher than historical level, and old forest single stratum stands exist at lower than historical levels (less late forest with open canopy and more late forest with closed canopy). With late and old forest structures outside the historical range, the Hot Dry plant association group falls under Scenario A of the Regional Forester's Forest Plan Amendment 2 (Eastside Screen). There is an opportunity to move old forest multi-strata to old forest single stratum to more align with the historical range of variability. Young forest multi-strata structure is currently above historical range of variability, and stand initiation is below historical range.

Table 8. Hot Dry plant association group historical range of variability analysis

Structure type	Percent historical range of variability ¹	Percent existing condition
Old forest single stratum	20-70%	8%
Old forest multi-strata	5-15%	50%
Young forest multi-strata	5-10%	19%
Stem exclusion open canopy	5-20%	15%
Stem exclusion closed canopy	0-5%	0%
Understory reinitiation	0-5%	7%
Stand initiation	5-15%	1%

1. From Powell (1998).

Stand density index calculations show 90 percent of the Hot Dry plant association group as being above the management zone, 7 percent is within the management zone, and only 3 percent is below the management zone recommended for Hot Dry plant association groups. There is an opportunity to move stands toward the management zone for healthy stands.

Table 9. Stand density in Hot Dry Upland Forest

Management zone	Percent existing condition
Below	3%
Within	7%
Above	90%

Warm Dry Plant Association Group

The Warm Dry plant association group includes ponderosa pine plant associations, Douglas-fir plant associations, and a few of the drier grand fir plant associations. All stands structural stages exist within the Warm Dry plant association group. Late and old structure includes old forest single stratum and old forest multi-strata. Approximately 28 percent of forested acres exhibit late and old structure characteristics within the Warm Dry areas of the Cliff Knox planning area. Currently old forest multi-strata stands occur at a higher than historical level, while old forest single stratum stands exist at a lower

than historical level (less late forest with open canopy and more late forest with closed canopy). Stem exclusion closed canopy is higher than historical level, and stand initiation is lower than historical level. Young forest multi-strata is slightly over historical level. With late and old forest structures outside the historical range, the Warm Dry plant association group falls under Scenario A of the Regional Forester's Forest Plan Amendment 2. There is an opportunity to move old forest multi-strata to old forest single stratum to more align with the historical range of variability.

Table 10. Warm Dry plant association group historical range of variability analysis

Structure type	Percent historical range of variability ¹	Percent existing condition
Old forest single stratum	15-55%	3%
Old forest multi-strata	5-20%	26%
Young forest multi-strata	5-25%	26%
Stem exclusion open canopy	5-20%	12%
Stem exclusion closed canopy	1-10%	17%
Understory reinitiation	1-10%	15%
Stand initiation	5-15%	1%

1. From Powell (1998).

Stand density index calculations show 86 percent of the Warm Dry plant association group as being above the management zone, 11 percent is within the management zone, and only 3 percent is below the management zone recommended for Warm Dry plant association groups. There is an opportunity to move stands toward the management zone for healthy stands.

Table 11. Stand density in Warm Dry Upland Forest

Management zone	Percent existing condition
Below	3%
Within	11%
Above	86%



Figure 6. Young pine encroaching into shrub area

Other Plant Association Groups

Approximately 780 acres of Hot Moist Upland Woodland, 440 acres of Cool Dry Upland Forest, 240 acres of Warm Moist Upland Shrub, 160 acres of Hot Dry Upland Woodland, 160 acres of Cold Dry Upland Forest, 120 acres of Warm Moist Upland Forest, and 30 acres of Hot Moist Upland Woodland are spread out across the planning area. Together, these make up less than 5 percent of the total area.

There are approximately 5 acres of old forest single stratum structural designation within the Cold Dry Upland Forest. No other late and old structure occurs within the other plant association groups listed above within the planning area. Within these plant association groups, approximately 86 percent of the forested stands are considered above management level using stand density index as a measuring tool.

Approximately 950 acres of upland woodland (Hot Moist and Hot Dry Upland Woodland) plant associations exist in the planning area. Upland woodlands are separated from upland forest to explicitly recognize that woodlands represent important differences in vegetation structure and function when compared to other forested lands and includes western juniper plant associations (Powell et al. 2007). Many of these upland woodland acres are stocked well above historical levels and show as forested within the forest vegetation simulator model.

Non-Forest Environments

Fifteen percent of the planning area is non-forested, including meadows and scab flats with vegetation such as mountain mahogany. Small meadows have experienced encroachment from conifer species.



Figure 7. Meadow in Cliff Knox planning area with lodgepole pine encroaching

Other Important Vegetation Communities

Mountain Mahogany

Conifers have begun to overshadow areas of mountain mahogany. Mountain mahogany is shade intolerant and is declining where competing conifer species encroach. If sites can support coniferous species, mountain mahogany may be replaced by conifers as dominate in the canopy (Gucker 2006). The Hot Dry Upland Forest, Warm Dry Upland Forest, and Hot Dry Upland Woodland plant association groups include areas of mountain mahogany.

There are many locations in the Cliff Knox planning area where mountain mahogany is being shaded out by young pine and juniper trees. Mountain mahogany is declining in vigor in those areas where it is

competing with young conifer trees. Some mountain mahogany seedlings are present but are being overshadowed by young conifers. Seeds germinate better on soils without litter (Ibáñez et al. 1999). Mountain mahogany provides excellent summer and winter forage for large ungulates. Mountain mahogany communities also provide excellent winter cover for big game (Gucker 2006). Big game feeding grounds show a reduction in area as conifers move into areas previously occupied by grasses and shrub species such as mountain mahogany.



Figure 8. Mountain Mahogany with pine and juniper encroaching



Figure 9. Small mountain mahogany seedling with young pine beginning to overshadow it

Aspen Stands

Quaking aspen is the most widespread tree species in North America (Baker 1925, Perala 1990, Swanson et al. 2010). It is a shade-intolerant, primary-successional hardwood species reliant upon vegetative growth induced by periodic disturbances such as fire, insects, and disease to ensure root suckering of clones (Bartos 2001, Shirley and Erickson 2001, Frey et al. 2003, Shepperd et al. 2006). There is a shared concern throughout the western United States about the decline of aspen. The consensus is that aspen decline is due to the lack of successful regeneration in existing stands due to conifer encroachment, the absence of natural fire regimes, and browsing pressures by ungulates (Bartos and Campbell 1998, Shepperd et al. 2006). Most aspen stands within the Cliff Knox planning area occur in Hot Dry Upland Forest and Warm Dry Upland Forest plant association groups.

Swanson et al. (2010) hypothesize that historically in the Blue Mountains, aspen was never as widespread as in other parts of the west; they propose that climate and conifer competition interacted to keep aspen abundance low compared to other areas. This lower abundance has made aspen more vulnerable to increased herbivory and fire suppression of the recent past (Swanson et al. 2010). Aspen in the Blue Mountains evolved with fire as the primary disturbance agent where it would remove competing conifers, kill mature aspen stems, and stimulate root-sprouting (Seager, et al 2015).

In the Cliff Knox planning area, aspen is a relatively minor component of the more widespread coniferous forests, comprising less than 5 percent of the planning area. Aspen is known to be found in approximately 70 locations within the Cliff Knox planning area. Aspen provides unique habitat for many wildlife species within coniferous forests and is currently reduced from its historical extent. It appears the combination of fire suppression, heavy browsing by both domestic and wild ungulates, conifer encroachment, and lowering of the water table have reduced the survival of aspen within the planning area. Some of these stands have been fenced to encourage sprouting, but many fences are in poor condition.



Figure 10. Older aspen stand with many young pine encroaching into the stand, very few aspen sprouts

Big Game Winter Range

Approximately 7,420 acres within the project area are designated as management area 4A, Big Game Winter Range. Approximately 740 acres of Big Game Winter Range exists on the west side of the Malheur River, and 6,680 acres on the east side of the river, mostly in the southern portion of the project area. Almost 4,500 acres of Big Game Winter Range is considered overstocked for healthy stands. The majority of these stands are within the Hot Dry Upland Forest and Warm Dry Upland Forest plant association groups. Soil maps show that a large proportion of the Cliff Knox planning area have mollic soils (Mollisols), which are created from lands predominantly covered by grasses.

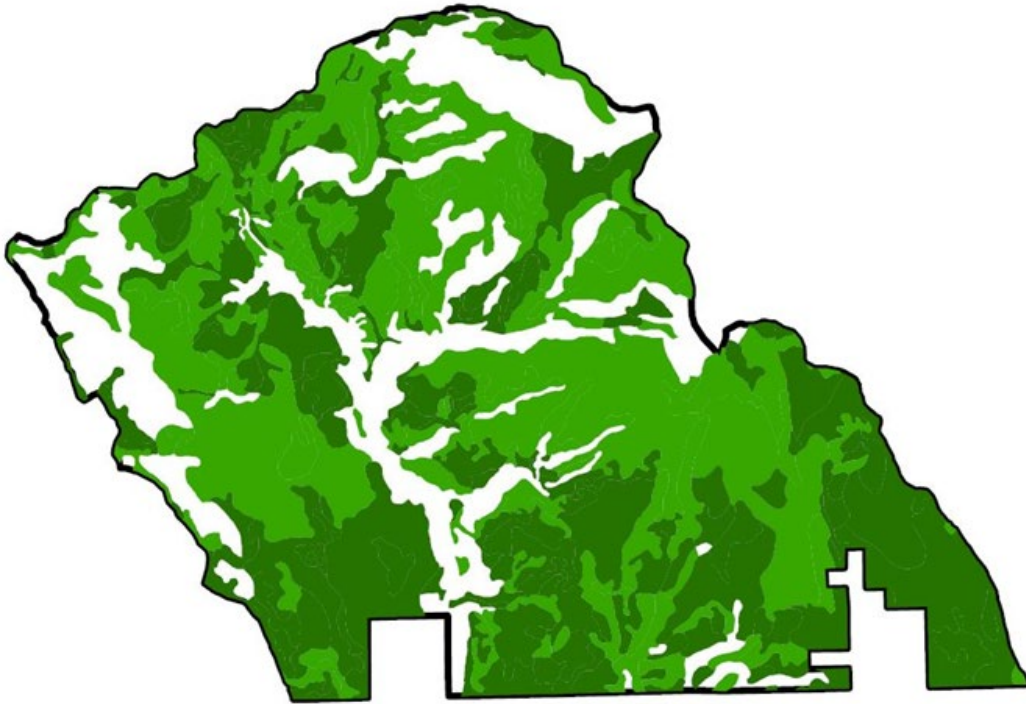


Figure 11. Map reflects areas of mollic soils in the Cliff Knox planning area with darker green areas identifying 100 percent and lighter green areas identifying 80-100 percent

Shrub Steppe

Shrub steppe areas exist throughout the Cliff Knox planning area. In many of these areas, woody vegetation has increased, often because of reduced fire frequency (Davies et al 2019). In the Cliff Knox planning area, ponderosa pine and juniper have encroached into areas previously composed of perennial grasses and sagebrush. These include stands within Hot Dry Upland Woodlands, Hot Moist Upland Woodlands, Hot Dry Upland Forest, and Warm Dry Upland Forest.

Desired Condition

The Malheur Forest Plan, as amended by the Regional Forester's Eastside Forest Plan Amendment 2 (Eastside Screens), provides the basis for actively addressing restoration towards the historical range of variability, and moving the area towards a more resistant and resilient landscape. Currently, values and features associated with and adjacent to the planning area including dispersed recreation sites, old growth management areas, wildlife habitat, riparian corridors, wild and scenic river corridor, and inventoried roadless area are susceptible to wide-scale disturbances due to existing stand density, structure, and species composition.

The desired future condition is to shift the Cliff Knox planning area to include the following elements:

- Move the landscape and stand types towards historical reference conditions for Warm Dry and Hot Dry ponderosa pine
- Increase the percentage of ponderosa pine, western white pine, and western larch; reduce Douglas-fir, grand fir, and western juniper
- Lower stand densities to increase tree growth and vigor and boost resistance to insects and disease, and increase longevity of remaining overstory ponderosa pine
- Where overstory ponderosa pine has succumbed to insect attack, ensure replacement trees are supplied to assist in the recovery of larger ponderosa pine numbers
- Promote healthy, reproducing stands of quaking aspen
- Promote mountain mahogany survival and regeneration
- Reintroduce fire as a process that perpetuates ponderosa pine as the major seral species by thinning fire sensitive species and by creating seed beds conducive to pine natural regeneration
- Restore fuel profiles to types primarily conducive to surface fire
- Increase stand resilience to fire, decrease resistance to control, increase firefighter effectiveness, increase safety of firefighters and the public
- Improve and increase browse opportunities for large ungulates, especially in areas of winter range
- Capture economic value of harvested timber

Obtaining these conditions would improve resiliency in the Cliff Knox planning area, by promoting an increase of tree growth and vigor, decreasing risk of uncharacteristically severe wildfire, and reducing the susceptibility of epidemic insect and disease outbreaks. Removal of forest products would create forest restoration job opportunities.

Environmental Consequences

Methodology

Information concerning stands has been gathered through a combination of photo interpretation, formal timber stand exams in 1999, 2001, 2002, 2005, 2013, 2014, and walk-throughs in 2016-2018.

Modeling was used to project stand development through 40 years for future structural stages, stand density, and species composition. The FS Veg Spatial Data Analyzer program was used to run the nearest neighbor analysis and forest vegetation simulator on all forested stands within the Cliff Knox planning area. The nearest neighbor analysis populates stands without current stand exam data using similar stands with exam data. The forest vegetation simulator model, with the Blue Mountains variant, was used to grow stands to 2019, and then apply prescriptions to the stands proposed and project stand growth and development for 40 years. All mechanical treatments proposed within the Cliff Knox planning area, as well as the first application of prescribed burning, were simulated in this analysis. Forest vegetation simulator projections were then used to compare stand structure and stand density, between the no action and action alternatives to determine if they met project goals. Long-term projections become estimates at best; however, results do show trends and are useful for comparing different alternatives.

Assumptions for estimating effects include:

- Historical range of variability approximates the desired future condition.
- The future climate would be within the current range of variation.
- Current insects and diseases would continue to inhabit the forest and populations would fluctuate depending on stand conditions.
- The current trends in forest stand composition, structure, and density would continue, assuming no further mechanical vegetation management would occur.
- Regeneration resulting from opening up stands in the Warm Dry plant association group would be kept at low levels by periodic underburning.

Assumptions for the FSveg Spatial Data Analyzer model include:

- Benchmarks for the future structural stage analysis are set at 10 and 40 years in the future.
- The mechanical treatments in the action alternatives are only applied once, at the start of the modeling time period. They are not repeated again within the 40-year modeling cycle.
- The prescribed burning in the action alternatives is only applied once in the first cycle of forest vegetation simulator. Prescribed burning was not repeated again within the 40-year modeling cycle.
- The stands without mechanical treatment or prescribed fire are grown using the assumptions for alternative 1.
- No other disturbances occur that result in stand replacement (wildfire, insects, wind, etc.).

The above modeling constraints are used to simplify the analysis and are only for comparative purposes between the no action and action alternatives. They are not intended to accurately predict actual future conditions. Based on science and professional knowledge, it is reasonable to believe that climate change and future disturbances would occur which would affect the vegetation in the Cliff Knox planning area.

Climate change, disturbance and insect and disease issues provide a level of uncertainty associated with forest vegetation response. Since the aforementioned model cannot predict future events, it assumes the future climate shall remain within the current range of variation and insects, diseases, flora, and fauna shall continue to inhabit the area and fluctuate in abundance according to stand conditions.

Halofsky and Peterson (2017) conducted a state-of-the-science climate change vulnerability assessment and developed adaptive management techniques for the Blue Mountains region. Global climate models predict that increasing air temperatures are expected to cause gradual changes in vegetation distribution and abundance, with more resilient, draught tolerant species increasing in numbers. Winter precipitation may increase, but the degree of change remains unknown.

Halofsky and Peterson (2017) provided management tactics that facilitate the Blue Mountains transition to a warmer climate while minimizing the negative effects of climate change. The Cliff Knox project implements similar strategies, by reducing surface fuels and forest density, encouraging regeneration, preventing damage from disturbance, establishing refugia for aspen and mountain mahogany stands, decreasing road/stream connectivity, and reducing conifer encroachment in riparian areas. For more information on climate change refer to the Climate section of this document.

Spatial and Temporal Context for Effect Analysis

The spatial boundary used for direct and indirect effects analysis include the Bluebucket Creek and Cliff Creek-Malheur River subwatersheds. This boundary includes National Forest System managed lands. The

boundary for the cumulative effects analysis includes the Cliff Knox planning area and the directly adjacent recent projects and associated subwatersheds. This includes the Wolf Project area to the west, the Knox Project to the east, and the Summit Project to the north and the Elk 16 Project to the northeast. This area is approximately 139,500 acres in addition to the 40,300 acres of the Cliff Knox planning area.

The timeframe for the direct and indirect effects of vegetation management is relatively short term for forest development. Direct and indirect effects are assessed 10 and 40 years after treatment. The timeframe for cumulative effects is relatively long term for forest development, and includes cumulative effects of past logging, current restoration treatments, and the Cliff Knox Project on species, composition, stand density and stand structure.

Past, Ongoing, and Reasonably Foreseeable Actions Relevant to Cumulative Effects Analysis

The past activities that have cumulative effects to forest vegetation within the Cliff Knox planning area as described in the Cliff Knox Project Final Environmental Impact Statement, Appendix D – Past, Ongoing, and Reasonably Foreseeable Actions include historical timber harvest, more recent timber harvesting in the 1970s through the 1990s, fire suppression, wildfire, timber salvage, planting following regeneration harvest, and livestock grazing. Most of these activities are discussed at length in the historical condition section of this report. Within stands previously harvested using regeneration harvests, replanting occurred using tight spacing parameters of up to 680 trees per acre, and planted predominantly ponderosa pine, western larch, and Douglas-fir. Dense planting, along with abundant natural regeneration in some areas, has resulted in young dense stands of predominantly early seral species.

Historical grazing practices began with primarily high numbers of sheep in the area in the late 1800s and early 1900s. In the early to mid-1900s, grazing transitioned into primarily cattle grazing and is currently 100 percent cattle grazing. Cattle numbers have dramatically decreased over time. Grazing is currently monitored and managed within and adjacent to the planning area. Due to historical grazing practices, fire suppression, and the climate of the early 1900s, natural regeneration of tree species was stimulated, beginning the density increases of the 20th century. Current grazing practices generally do not impact the competing vegetation enough to influence natural regeneration success.

The recent past and present activities having cumulative effects to forest vegetation include plantation maintenance, Summit Project, Wolf project, Elk 16 Project, Knox Project broadcast burning, grazing as stated above, and continued fire suppression. The Riparian Thin Project west of the Malheur River treated approximately 30 acres along riparian corridors. This project was completed in 2018 and consisted of thinning trees less than nine inches diameter at breast height.

The Elk 16 Project planned approximately 23,000 acres to be mechanically thinned. Mechanical treatments include commercial thinning, noncommercial thinning, and aspen restoration. Most of the thinned areas would also have some fuels treatments. This project was on the Crane Creek and Elk Creek-North Fork subwatersheds and was implemented to improve forest health by moving stands toward historical conditions. Approximately 50 percent of the planned activities are complete.

The Summit Project is in the midst of harvest activities. Approximately 11,600 acres of mechanical treatment and 100 acres of aspen treatments are planned. Precommercial and biomass treatments are planned over approximately 14,000 acres. Activity fuels treatments are planned in association with both commercial and precommercial thinning areas as conditions allow.

The Wolf Project is mechanically thinning approximately 26,500 acres. Mechanical treatments include commercial and noncommercial thinning. Some skyline units are currently planned. A large portion of the

harvest activities have occurred. Prescribed burning units are partially complete and would continue as conditions allow.

The Knox Project has mechanically thinned 3,390 acres. Mechanical treatments include commercial thinning and noncommercial thinning. Commercial treatments are complete, and prescribed burning units are partially completed and would continue as conditions allow.

Alternative 1 – No Action

Direct and Indirect Effects

Current and future conditions as compared to historical range of variability according to stand structure are as follows, assuming no actions are taken in the planning area.

Given no action, the Cliff Knox planning area would continue its current growing trajectory. Forest stands would continue to be overstocked. Modeling shows stand structure would move toward more old forest multi-strata.

Overall forest structure over time would increase late and old structure (old forest single stratum and old forest multi-strata) from 31 percent to 68 percent. However, the ratio of multi-strata to single stratum would continue to be opposite of what was present historically in the majority of the planning area. Historically, drier plant association groups, such as Hot Dry and Warm Dry Upland Forest, had a higher percent of old forest single stratum compared to old forest multi-strata. No forest products would be removed, and no forest restoration jobs would be created given no activities.

Table 12. Overall forest structure

Structure type	Percent existing condition	Percent alternative 1, 2023	Percent alternative 1, 2053
Old forest single stratum	3%	4%	13%
Old forest multi-strata	28%	35%	55%
Young forest multi-strata	25%	28%	10%
Stem exclusion open canopy	13%	10%	4%
Stem exclusion closed canopy	14%	14%	17%
Understory reinitiation	15%	9%	1%
Stand initiation	2%	0%	0%

Hot Dry Plant Association Group

Stand Density

Given no action, the species composition in ponderosa pine plant associations stands would continue to be predominantly ponderosa pine over time. However, there would continue to be a decrease in abundance of ponderosa pine within this plant association group and an increase in abundance of western juniper in the drier stands. The proportion of Hot Dry Upland Forest within or below management zone for stand density would fall to less than one percent and almost all of the Hot Dry stands would be above management zone in 40 years. This would lead to slower growth rates over time and increase the possibility of density-induced mortality due to water and nutrient competition, as well as higher probability for epidemic levels of beetle activity. These dense stands would also be more disposed to uncharacteristically severe fires.

Table 13. Stand density index ranges in the Hot Dry Upland Forest for alternative 1 within the Cliff Knox planning area

Management zone	Percent existing condition	Percent 2023	Percent 2053
Below	3%	<1%	0%
Within	7%	6%	<1%
Above	90%	94%	100%

Structure and the Historical Range of Variability

Table 14 below displays how alternative 1 within the Hot Dry plant association group compares to historical range of variability through time. Late and old structure would continue to increase but not correspond with the historical range of variability; the ratio of multi-strata to single stratum would continue to be reversed from what was present historically in the majority of the planning area (more late forest with closed canopy and less late forest with open canopy).

Table 14. Hot Dry plant association group historical range of variability analysis for alternative 1

Structure type	Percent historical range of variability	Percent existing condition	Percent 2023	Percent 2053
Old forest single stratum	20-70%	8%	7%	14%
Old forest multi-strata	5-15%	50%	56%	75%
Young forest multi-strata	5-10%	19%	25%	4%
Stem exclusion open canopy	5-20%	15%	6%	7%
Stem exclusion closed canopy	0-5%	0%	0%	0%
Understory reinitiation	0-5%	7%	6%	0%
Stand initiation	5-15%	1%	0%	0%

Warm Dry Plant Association Group

Stand Density

Given no action, the species composition in ponderosa pine plant associations, Douglas-fir plant associations, and a few of the drier grand fir plant associations stands would continue to be predominantly ponderosa pine, Douglas-fir, and western larch over time. Late seral species in the mixed conifer stands would continue to increase in abundance. The proportion of area below or within the management zone would decrease and in 40 years would only be approximately two percent of the area within the management zone for the Warm Dry Plant Association Group. This would lead to slower growth rates over time and increase the possibility of density-induced mortality due to water and nutrient competition, as well as higher probability for epidemic levels of beetle activity. These dense stands would also be more disposed to uncharacteristically severe fires.

Table 15. Stand density index ranges for the Warm Dry Upland Forest stands for alternative 1 within the Cliff Knox planning area

Management zone	Percent existing condition	Percent 2023	Percent 2053
Below	3%	1%	0%
Within	11%	5%	2%
Above	86%	94%	98%

Structure and the Historical Range of Variability

Table 16 below displays how alternative 1 within the Warm Dry plant association group compares to the historical range of variability through time. Over time, old forest multi-strata would continue to be above the historical range of variability (more late forest with closed canopy), increasing to encompass approximately half of the area within the Warm Dry plant association group. Old forest single stratum would move toward but remain lower than the historical range of variability (less late forest with open canopy). The trend after 40 years would move the Warm Dry plant association group to show a deficiency in stand initiation and stem exclusion open canopy, and high in stem exclusion closed canopy stands.

Table 16. Warm Dry plant association group historical range of variability analysis for alternative 1

Structure type	Percent historical range of variability ¹	Percent existing condition	Percent 2023	Percent 2053
Old forest single stratum	15-55%	3%	4%	13%
Old forest multi-strata	5-20%	26%	31%	53%
Young forest multi-strata	5-25%	26%	29%	11%
Stem exclusion open canopy	5-20%	12%	10%	3%
Stem exclusion closed canopy	1-10%	17%	16%	19%
Understory reinitiation	1-10%	15%	10%	1%
Stand initiation	5-15%	1%	0%	0%

1. From Powell 1998

Non-Forest Environments

Given no action, dry meadows and scablands would continue to be encroached upon by juniper and conifers and would continue to decrease in size and extent across the planning area.

Other Plant Association Groups

Hot Moist Upland Woodland, Cool Dry Upland Forest, Warm Moist Upland Shrub, Hot Dry Upland Woodland, Cold Dry Upland Forest, Warm Moist Upland Forest, and Hot Moist Upland Woodland totaling approximately 1,900 acres are spread out across the planning area. Together, these make up less than 5 percent of the total area. Approximately 86 percent of these stands are considered above management level using stand density index.

There are approximately 5 acres of old forest single stratum structural designation within the Cold Dry Upland Forest. No other late and old structure occurs within the other plant association groups listed above within the planning area boundary.

Given no treatment, all stands would move above the recommended management zone for stand density for those plant association groups. This would lead to slower growth rates over time and increase the possibility of density-induced mortality due to water and nutrient competition, as well as higher probability for epidemic levels of beetle activity. These dense stands would also be more disposed to uncharacteristically severe fires. The upland woodlands and upland shrub plant associations would continue to have conifers encroaching, reducing open areas, and increasing stress on shrubs and hardwood species by competing for water and other resources.

Other Important Vegetation Communities

Mountain Mahogany

Mountain mahogany would continue to be impacted by conifer and juniper encroachment as well as ungulate use and would continue to be reduced from its historical extent.

Aspen Stands

Given no action, fire suppression, conifer encroachment, grazing by both domestic livestock and wild ungulates, and lowering of the water table would continue at its current rate. Since most of the aspen stands within Cliff Knox occur within dense stands of closed canopy and multi-story conifers, conifers would continue to shade out existing aspen. Many of the mature aspen trees are close to the end of their natural life cycle; however, some aspen have been regenerating in many of these stands. If existing fences are not repaired or expanded, it is likely continuing browse may prevent aspen suckering any further and prevent aspen stands from expanding their extent within the Cliff Knox planning area.

Big Game Winter Range

Given no action, the area would continue to have conifers encroach into more open areas, and stands would continue to be overstocked, reducing browse species. Natural fire would continue to be suppressed, and no prescribed fires would occur, allowing regeneration of conifers to continue at the current rate. Over time, this would increase coniferous cover and decrease available forage for ungulates.

Shrub Steppe

Given no action, conifers would continue to encroach into the shrub steppe areas. Natural fire starts would continue to be suppressed, eliminating natural thinning by fire. Juniper would continue to persist, regenerate, and expand across the landscape. Dry meadows and scablands would continue to be encroached upon by juniper and other conifers, creating more woodland habitat across the planning area.

Cumulative Effects

Because there are no direct or indirect effects, there would be no cumulative effects. However, the effects from past practices (which include timber harvesting, fire suppression, intense grazing, wildfire, and tree planting) have created predominantly young, overstocked stands which include some late seral species currently persisting across the planning area. Taking no action to reduce density or shift species composition through either mechanical methods or prescribed burning in the project would keep the area on its current trajectory and increase the risk of large-scale, stand-replacement fire and continued epidemic levels of insect outbreaks. The most recent small treatments in the planning area are not large enough or widespread enough to effectively reduce the risk to mid and old forest structure across the planning area.

Alternative 2

Design Criteria and Mitigation Measures

The vegetation and prescribed fire design measures are included in the Silviculture Prescription and Cliff Project Knox Final Environmental Impact Statement, Appendix C – Project Design Criteria. This prescription includes a discussion of the general tree selection guidelines, a detailed discussion of each of the mechanical treatment methods and their respective tree selection guidelines, and a detailed discussion of the prescribed burning with mortality guidelines.

A project design criterion included in the Cliff Knox Project Final Environmental Impact Statement, Appendix C – Project Design Criteria limits direct ignition during prescribed burning in the plantations until they have reached an average diameter at breast height of 7.0 inches. This design measure is intended to limit mortality from burning in these plantations and does not preclude prescribed fire backing into plantations having a mean diameter at breast height of less than 7.0 inches.

Direct and Indirect Effects – Silviculture Treatments

Alternative 2 proposes to mechanically treat approximately 27,300 acres (including about 600 acres of aspen restoration treatments) acres and prescribe burn approximately 40,250 acres. Restoration activities include dry pine restoration, pine savannah habitat restoration, old growth habitat and connectivity enhancement, aspen restoration, riparian restoration, mountain mahogany restoration, shrub steppe restoration, and meadow enhancement. Treatments include commercial thinning, small diameter thinning (including biomass or post and pole removal), noncommercial thinning, piling of activity and natural fuels, lop and scatter, chipping, pruning, burning of piled material, and underburning. Restoration treatments also include commercial and non-commercial thinning in the Malheur River Inventoried Roadless Area (including thinning pine-dominant areas within the inventoried roadless area), and commercial thinning within old growth habitat and connectivity enhancement units (within replacement old growth and connectivity stands). See the Cliff Knox Environmental Impact Statement, chapter 2 for proposed acres of activities and treatments.

Collectively, these treatments would reduce the proportion of stands existing above management zones for stand density. It is recommended in the Insect and Disease Report (Johnson and McWilliams 2016) that stands be moved slightly below the management zone to allow forest to move toward the management zone. Reducing stand density to at least the lower limit of the management zone helps reduce moisture stress due to competition, improving tree vigor, resiliency, and resistance to key pests. (Powell, 1999; Johnson and McWilliams 2016).

Given these treatments, overall late and old structure forest structure (old forest single stratum and old forest multi-strata) would increase over time from 31 percent to 55 percent. The ratio of old forest multi-strata to old forest single stratum would start moving toward historical level in the Hot Dry and Warm Dry Upland Forest areas that make up 98 percent of the upland forested acres within the planning area. Old forest single stratum in both Hot Dry and Warm Dry areas would increase over 40 years and move into historic range of variability. Old forest multi-strata in Hot Dry moves close to historic range after treatment but moves further away from historic range after 40 years. Old forest multi-strata in Warm Dry areas moves into historic range after treatment, but with no further treatment, moves out of historic range after 40 years. See Table 19 and Table 21 below. Forest products would be removed, and forest restoration jobs would be created with the proposed activities.

Table 17. Overall forest structure for alternative 2

Structure type	Percent existing condition	Percent post action alternative 2023	Percent post action alternative 2053
Old forest single stratum	3%	23%	32%
Old forest multi-strata	28%	15%	23%
Young forest multi-strata	25%	6%	3%
Stem exclusion open canopy	13%	37%	21%
Stem exclusion closed canopy	14%	9%	13%
Understory reinitiation	15%	4%	1%

Structure type	Percent existing condition	Percent post action alternative 2023	Percent post action alternative 2053
Stand initiation	2%	6%	6%

Table reflects all the stands in the project area. No harvest activities are planned in late and old seral stage stands within cool moist or cold moist plant association groups.

Hot Dry Plant Association Group

Stand Density

Alternative 2 proposes to mechanically treat approximately 3,700 acres and prescribe burn approximately 100 percent of the Hot Dry plant association group. Given these actions, the species composition in all stands would continue to be predominantly ponderosa pine over time. Most natural regeneration would be killed with prescribed burning. Collectively, these treatments would reduce the proportion of the Hot Dry plant association group existing above the management zone, from approximately 90 percent to 60 percent directly after treatment. When comparing density over 40 years, predictions for alternative 2 show densities would be lower given treatment, with approximately 30 percent of the Hot Dry plant association group within or below the management zone, as compared to less than one percent for alternative 1. It is recommended in the Insect and Disease Report (Johnson, M.; McWilliams, M. 2016) that stands be moved slightly below the management zone to allow the forest to grow into the management zone.

Table 18. Stand density index ranges for the Hot Dry Upland Forest stands for alternative 2 within the Cliff Knox planning area

Management zone	Percent existing condition	Percent 2016 (post activity)	Percent 2023	Percent 2053
Below	3%	29%	25%	22%
Within	7%	12%	10%	8%
Above	90%	59%	65%	70%

Structure and the Historical Range of Variability

Table 19 displays how alternative 2 within the Hot Dry plant association group compares to the historical range of variability through time. Over time, old forest multi-strata (late forest with closed canopy) would decrease in abundance closer to the historical range, and old forest single stratum (late forest with open canopy) would increase to within historical range.

Table 19. Hot Dry plant association group historical range of variability analysis for alternative 2

Structure type	Percent historical range of variability ¹	Percent existing condition	Percent 2023	Percent 2053
Old forest single stratum	20-70%	8%	43%	61%
Old forest multi-strata	5-15%	50%	21%	27%
Young forest multi-strata	5-10%	19%	4%	1%
Stem exclusion open canopy	5-20%	15%	18%	9%
Stem exclusion closed canopy	0-5%	0%	0%	0%
Understory reinitiation	0-5%	7%	5%	0%
Stand initiation	5-15%	1%	9%	2%

1. From Powell 1998

Warm Dry Plant Association Group

Stand Density

Alternative 2 would mechanically treat approximately 21,100 acres and prescribe burn approximately 100 percent within the Warm Dry plant association group. Given these actions, the species composition in all stands treated would continue to be predominantly ponderosa pine over time. The proportion of ponderosa pine would increase directly after treatment, while the proportion of grand fir would decrease. Over time stand density above management zone would remain below 50 percent, when compared to existing condition of over 80 percent.

Table 20. Stand density index ranges for the Warm Dry Upland Forest stands for alternative 2 within the Cliff Knox planning area

Management zone	Percent existing condition	Percent 2016	Percent 2023	Percent 2053
Below	3%	47%	38%	32%
Within	11%	20%	21%	21%
Above	86%	33%	41%	47%

Structure and the Historical Range of Variability

Table 21 displays how alternative 2 within the Warm Dry plant association group compares to the historical range of variability through time. Over time, old forest multi-strata (late forest with closed canopy) would decrease into the historical range, but without further treatments, it would move above the historical range within 40 years. Old forest single stratum (late forest with open canopy) would increase to within historical range.

Table 21. Warm Dry plant association group historical range of variability analysis for alternative 2

Structure type	Percent historical range of variability ¹	Percent existing condition	Percent 2023	Percent 2053
Old forest single stratum	15-55%	3%	20%	28%
Old forest multi-strata	5-20%	26%	14%	24%
Young forest multi-strata	5-25%	26%	6%	3%
Stem exclusion open canopy	5-20%	12%	40%	23%
Stem exclusion closed canopy	1-10%	17%	10%	15%
Understory reinitiation	1-10%	15%	4%	<1%
Stand initiation	5-15%	1%	5%	7%

1. From Powell 1998.

Non-Forest Environments

Approximately 170 acres of Warm Dry Upland Forest and non-forested plant association groups are planned for meadow enhancement activities. This includes removal of encroaching conifers, seeding native grasses, and planting or seeding native shrub species to move the meadow area toward more historical species composition. Returning fire to the landscape would assist in retention of the meadow areas.

Other Plant Association Groups

Alternative 2 activities planned within other plant association groups including the following: Approximately 50 acres in the Warm Moist Upland Forest, thinning a young plantation; approximately 90 acres of Cool Dry Upland Forest, related to meadow enhancement; and approximately 740 acres of Hot Dry Upland Woodland and Hot Moist Upland Woodland, linked to shrub steppe and mountain mahogany restoration. Together, these proposed activities comprise less than three percent of the upland forest and upland woodland plant association groups within the Cliff Knox planning area.

There are approximately 5 acres of old forest single stratum structural designation within the Cold Dry Upland Forest. Alternative 2 has no planned treatment for late and old forest in Cold Dry Upland Forest. No other late and old structure occurs within the other plant association groups listed above within the project area boundary.

As described in Existing Condition, these plant associations do not encompass large enough areas to analyze them individually. The proposed activities are predicted to assist restoration activities by removing conifer encroachment from meadow, shrub step and upland woodland areas, and reduce stand density in forested stands.

Other Important Vegetation Communities

Mountain Mahogany Restoration

Conifer reduction is proposed in areas where conifers have encroached into what used to be predominantly mountain mahogany thickets. In four commercial and small diameter thinning units, across approximately 290 acres, where mountain mahogany is a major component, young, large conifers (less than 150 years old and greater than 21 inches diameter at breast height) would be removed. Approximately 220 acres of proposed mountain mahogany units are located within Hot Dry plant association groups, 40 acres occur within Warm Dry plant association groups, and 30 acres occur within Hot Dry Upland Woodland plant association groups. One additional old forest multi-strata stand (15 acres) in the Hot Dry Upland Forest plant association group is proposed for mountain mahogany restoration. The minor number of young but large trees (less than 150 years and over 21 inches diameter at breast height) that would be removed would not reduce the stand to less than 10 large trees per acre. This stand would be converted from old forest multi-strata to old forest single stratum and there would be no net loss of late and old structure as a result of treatment.

In additional forest restoration and unique habitat restoration units where mountain mahogany is found in small patches, young competing conifers within 30 feet of the mahogany patch would be removed, with specific direction to avoid any damage to mountain mahogany plants. No old or large trees as defined by the 2021 amended Eastside Screens would be removed.

Removal of conifer competition should allow mountain mahogany, a shade intolerant species, to better survive and begin to inhabit the areas where it historically occurred. While mountain mahogany is resistant to drought, it is also intolerant to shade. In some areas, there has been enough moisture to allow young conifers to reach diameters over 21 inches. Removing conifers would allow full sunlight to reach the mountain mahogany plants (Gucker, C.L. 2000).



Figure 12. Mountain mahogany with juniper and ponderosa pine encroaching



Figure 13. Young mountain mahogany starts in openings where pine is beginning to encroach

Aspen Restoration

Alternative 2 would mechanically treat and may prescribe burn approximately 600 acres of aspen. Treatment would include commercial, small diameter, and non-commercial removal of conifers. No commercial or small diameter removal, or mechanical fuels treatments would occur in riparian habitat conservation areas. Within aspen stands, young (less than or equal to 150 years old), competing conifers within 150 feet of any aspen tree or sprouts would be removed (Blue Mountains Forest Partners 2017). In all but six aspen restoration stands, no large trees as defined by the amended Eastside Screens¹ would be removed. Approximately 120 acres in six aspen units are proposed for removal of young, large conifer trees (less than 150 years old and greater than 21 inches diameter at breast height) where shade and moisture competition are considered detrimental to aspen survival. Decreased competition for resources, increased sunlight, and minor ground disturbance would promote aspen sprouting and allow current stands to expand (Seager, et al 2015). Removal of young, large trees would not result in a loss of late and old structure in the Cliff Knox planning area, as these stands do not currently meet that definition.

Plant association groups associated with proposed aspen units include approximately 530 acres of Hot Dry Upland Forest, approximately 30 acres of Warm Dry Upland Forest, and approximately 30 acres of non-forest.

¹ The 2021 amended Eastside Screens defines large trees as grand fir and white fir greater than or equal to 30 inches diameter at breast height or trees of any other species greater than or equal to 21 inches diameter at breast height.

Several aspen units have existing fences and cages. Cages would be removed, and larger exclosures would be built if necessary. Where fences currently exist, they would be considered for modifications to better promote aspen regeneration. In areas of aspen not yet fenced, annual inspections of the areas would be made and if, within three- to five- years, grazing from ungulates such as elk and livestock is determined to negatively impact aspen restoration, fences would be designed and constructed to best protect and encourage regeneration of aspen. No small “cages” would be used in aspen restoration stands.



Figure 14. Older aspen with young pine encroaching, very few aspen sprouting



Figure 15. One older aspen within some large older pine, with a few aspen sprouts in the foreground and encroaching young pine in the background

Big Game Winter Range

Approximately 800 acres (16 units) are proposed to be thinned to move those stands back to an open pine savannah condition, with wildlife browse species being seeded or planted in the openings created. As much of the area has soils formed under grasslands, the emphasis in these areas is to return it to an open grassland with fewer larger trees. These areas have been strategically located to utilize natural existing openings to utilize natural seed sources where possible. Removing conifers and seeding grasses and other browse species would help improve winter range habitat for large ungulates, allowing more access to winter forage.

Approximately 240 acres occur in Warm Dry Upland Forest, 110 acres in Hot Moist Upland Woodland, and 440 acres in Hot Dry Upland Forest plant association groups.

Shrub Steppe Restoration

Approximately 1,840 acres are proposed for mechanical treatment in areas where conifers have encroached into areas of scab flats, sagebrush, and meadow areas. Treatments would include diameter and non-commercial thinning. Within the Malheur River Inventoried Roadless Area, approximately 590 acres are proposed for non-commercial hand thinning followed by piling or lop and scatter.

The soils of the area are Mollisols. These mineral soils have developed on grasslands, a vegetation that has extensive fibrous root systems (Plant & Soil Sciences eLibrary 2020). Removing conifers that have encroached would allow for sagebrush and grassland areas to recover back to the open areas that occurred historically. Juniper and other conifers not exhibiting old growth characteristics would be felled, and either piled and burned, or lopped and scattered. Prescribed burning would decrease the number of conifer seedlings reaching maturity. In addition to harvesting encroaching conifer, seeding and planting of native grasses and shrub species is proposed for these areas to assist recovery. Proposed activities would allow shrub steppe areas to return to a more historical open, brushy environment.

Activities are proposed in parts of the following plant association groups: approximately 380 acres in Hot Dry Upland Forest, 870 acres in Warm Dry Upland Forest, 90 acres in Hot Dry Upland Woodland, and 510 acres in Hot Moist Upland Woodland.

Disturbance Processes

When compared to alternative 1 (no action), alternative 2 would decrease stand densities and the proportion of late seral species across the planning area. This would decrease the risk of insect outbreaks of mountain pine beetle and western pine beetle. It would also decrease the effects of mistletoe and Annosus root disease. Mechanical treatments and prescribed burning are designed to develop forest structure that would have been developed across the landscape given historical fire regimes in the Cliff Knox planning area. Where fires burned very frequently with low intensity, stands have been prescribed treatments thinning from below to raise the canopy base height and increase the average diameter at breast height of the stand and leave predominantly early seral species.

Direct and Indirect Effects – Prescribed Burning and Unplanned Ignitions

The direct and indirect effects of prescribed burning have been discussed in the Silviculture Treatments section because these treatments were modeled together using the FSveg Spatial Data Analyzer model and together they affect stand structure, density, and species composition.

Direct and Indirect Effects – Road Activities

The direct and indirect effects of road activities to forest vegetation include the cutting of trees to facilitate road maintenance, road relocation, and temporary road construction. The removal of trees for these activities is generally localized and would be additive to the effects discussed above for silvicultural treatments. However, these effects would be minimal across the planning area and would only slightly change the effects to stand density and forest structure as discussed previously. There would be no direct or indirect effects to forest vegetation from changes to the road system because the roads being decommissioned would not be needed for future management access. All other roads (closed and open) would be available for future management needs.

Direct and Indirect Effects – Strategic Road Treatments

Strategic roads treatments are proposed to better set up landscapes for restoration by unplanned ignitions in a cost-effective manner, and to improve access and egress for firefighters and public when wildfires occur. Alternative 2 proposes a 150-foot buffer from strategic roads. Along these strategic roads, thinning would utilize even spacing, and place any leave patches outside the buffer. Even spacing would create an open appearance but would not change the overall stocking levels after proposed action occurs.

Direct and Indirect Effects – Insect and Disease Harvest

The Cliff Knox planning area has been affected by pine butterfly activity, drought, and mountain pine beetle activity. Harvest of trees that have recently died (and still have red needles) may be considered for harvest, as long as Malheur Forest Plan and DecAID snag requirements are met. Additional green trees may be left for future snag recruitment. Implementation would co-occur with commercial and small diameter thinning units and would be prohibited within riparian habitat conservation areas, the Malheur Inventoried Roadless Area, Malheur Wild and Scenic River Corridor (management area 22), old growth (management area 13), and connectivity corridors. Generally, there would be no net changes from proposed action. Removal of some dead material can serve as a tool for managing fuels after a disturbance, and when applied using best management practices along with mechanical thinning, prescribed fire, and managed low to mixed severity wildfires, can restore the area to a low and mixed severity fire regime more in line with historical conditions (Peterson et al 2015).

Cumulative Effects

The effects from past practices which include timber harvesting, fire suppression, grazing, wildfire, and planting have created predominantly young, overstocked stands across the planning area. Alternative 2 would use mechanical methods in approximately 27,300 acres and prescribed burning in approximately 40,250 acres. These treatments would reduce stand density and shift structure of the treated stands in predominantly mid-successional and older forest stands in all plant association groups within the planning area. Native grasses and browse species would be seeded or planted after treatment to help improve forage in Big Game Winter Range. Untreated stands would continue on the current trajectory as defined in alternative 1 (no action).

The actions within the Cliff Knox planning area, as well as past, ongoing, and reasonably foreseeable actions described earlier would cumulatively have an effect on the Bluebucket Creek and Cliff Creek-Malheur River subwatersheds (see Cliff Knox Project Final Environmental Impact Statement, Appendix D – Past, Ongoing and Reasonably Foreseeable Actions). These actions would reduce stand density, shift species composition to a larger proportion of early seral species and move stand structure towards the historical range of variability to decrease the risk of large-scale, stand-replacement fire and epidemic insect outbreaks in the Malheur River drainage where it flows through National Forest System managed lands in the southeastern area of the Malheur National Forest. For more discussion regarding the

cumulative effects to stand structure within the Malheur River drainage, refer to Cliff Knox Project Final Environmental Impact Statement, chapter 3, Evaluation of Proposed Forest Plan Amendments section. Together, these projects would mechanically thin approximately 77 percent of the forest or woodland areas and prescribe burn 100 percent of the cumulative effects area over an approximate 25-year period.

Alternative 3

Design Criteria and Mitigation Measures

The vegetation and prescribed fire design measures are included in the Silviculture Prescription and Cliff Knox Project Final Environmental Impact Statement, Appendix C – Project Design Criteria. Mitigation measures for alternative 3 are the same as for alternative 2.

Direct and Indirect Effects – Silviculture Treatments

Alternative 3 proposes to mechanically treat 26,400 acres (including about 600 acres of aspen restoration treatments) and prescribe burn approximately 32,970 acres. Restoration treatments and activities are similar to alternative 2 except that alternative 3 would not include commercial thinning in the Malheur River Inventoried Roadless Area, proposes noncommercial thinning only in the dry pine and shrub steppe restoration areas within the inventoried roadless area, and excludes any commercial thinning within old growth habitat and connectivity enhancement units (replacement old growth and connectivity corridors). See Cliff Knox Environmental Impact Statement, chapter 2 for proposed acres of activities and treatments.

Collectively, these treatments would reduce the proportion of stands existing above management zones for stand density. It is recommended in the Insect and Disease Report (Johnson, M.; McWilliams, M. 2016) that stands be moved slightly below the management zone to allow forest to move toward the management zone. Reducing stand density to at least the lower limit of the management zone helps reduce moisture stress due to competition, improving tree vigor, resiliency, and resistance to key pests. (Powell, 1999; Johnson, M.; McWilliams, M. 2016)

Given the proposed treatments in alternative 3, late and old structure (old forest single stratum and old forest multi-strata) would increase over time similar to the expected effects in alternative 2. Slightly fewer acres would be treated in alternative 3, resulting in a slightly smaller percentage of old forest single stratum post-treatment. See Table 24 and Table 26 below. Slightly fewer forest products would be removed, and forest restoration jobs created by alternative 3 proposed activities.

Table 22. Overall forest structure for alternative 3

Structure type	Percent existing condition	Percent post actions 2023	Percent 2053
Old forest single stratum	3%	22%	30%
Old forest multi strata	28%	15%	25%
Young forest multi strata	25%	7%	3%
Stem exclusion open canopy	13%	36%	20%
Stem exclusion closed canopy	14%	10%	13%
Understory reinitiation	15%	4%	1%
Stand initiation	2%	6%	8%

Table reflects all the stands in the project area. No harvest activities are planned in late and old seral stage stands within cool moist or cold moist plant association groups.

Hot Dry Plant Association Group

Stand Density

Alternative 3 proposes to mechanically treat approximately 3,200 acres and prescribe burn approximately 100 percent of the Hot Dry plant association group. Given these actions, the species composition in all stands would continue to be predominantly ponderosa pine over time. Most natural regeneration would be killed with prescribed burning. Collectively, these treatments would reduce the proportion of the Hot Dry plant association group existing above the management zone, from approximately 90 percent to 60 percent directly after treatment. When comparing density over 40 years, predictions for alternative 3 show densities would be lower given treatment, with approximately 30 percent of the Hot Dry plant association group within or below the management zone, as compared to less than one percent for alternative 1. It is recommended in the Insect and Disease Report (Johnson, M.; McWilliams, M. 2016) that stands be moved slightly below the management zone to allow the forest to grow into the management zone.

Table 23. Stand density index ranges for the Hot Dry Upland Forest stands for alternative 3 within the Cliff Knox planning area

Management zone	Percent existing condition	Percent 2016 (post activity)	Percent 2023	Percent 2053
Below	3%	29%	23%	21%
Within	7%	12%	16%	11%
Above	90%	59%	61%	68%

Structure and the Historical Range of Variability

Table 24 displays how alternative 3 within the Hot Dry plant association group compares to the historical range of variability through time. Over time, old forest single stratum (open canopy) would increase to within the historical range of variability, and old forest multi-strata (closed canopy) would decrease toward historical levels directly after treatment but would begin increasing further above the historical range if no further actions are taken.

Table 24. Hot Dry plant association group historical range of variability analysis for alternative 3

Structure type	Percent historical range of variability ¹	Percent existing condition	Percent 2023	Percent 2053
Old forest single stratum	20-70%	8%	43%	62%
Old forest multi-strata	5-15%	50%	21%	26%
Young forest multi-strata	5-10%	19%	6%	1%
Stem exclusion open canopy	5-20%	15%	17%	9%
Stem exclusion closed canopy	0-5%	0%	0%	0%
Understory reinitiation	0-5%	7%	5%	0%
Stand initiation	5-15%	1%	7%	2%

1. From Powell 1998.

Warm Dry Plant Association Group

Stand Density

Alternative 3 would mechanically treat approximately 20,800 acres and prescribe burn approximately 90 percent of the Warm Dry plant association group. Given these actions, the species composition in all stands treated would continue to be predominantly ponderosa pine over time. The proportion of

ponderosa pine would increase directly after treatment, while the proportion of grand fir would decrease. Collectively, these treatments would reduce the proportion of the stands that exist above the management zones.

Table 25. Stand density index ranges for the Warm Dry Upland Forest stands for alternative 3 within the Cliff Knox planning area

Management zone	Percent existing condition	Percent 2016	Percent 2023	Percent 2053
Below	3%	46%	40%	30%
Within	11%	20%	21%	22%
Above	86%	34%	39%	48%

Structure and the Historical Range of Variability

Table 26 displays alternative 3 within the Warm Dry plant association group compared to the historical range of variability through time. Old forest multi-strata would decrease into the historical range, but with no other activities modeled into the future, it would move above the historical range within 40 years. Old forest single stratum would move into historical range of variability and increase over time but would stay within the historical range of variability. Over time, old forest multi-strata and old forest single stratum (together referred to as late and old structure stands) would occupy approximately 50 percent of the landscape.

Table 26. Warm Dry plant association group historical range of variability analysis for alternative 3

Structure type	Percent historical range of variability ¹	Percent existing condition	Percent 2023	Percent 2053
Old forest single stratum	15-55%	3%	19%	26%
Old forest multi strata	5-20%	26%	14%	25%
Young forest multi-strata	5-25%	26%	7%	3%
Stem exclusion open canopy	5-20%	12%	39%	22%
Stem exclusion closed canopy	1-10%	17%	11%	15%
Understory reinitiation	1-10%	15%	4%	1%
Stand initiation	5-15%	1%	6%	9%

1. From Powell (1998).

Non-Forested Environments

Proposed activities are the same for alternatives 2 and 3, therefore the effects would be the same.

Other Plant Association Groups

Proposed activities are the same for alternatives 2 and 3, therefore the effects would be the same.

As described in Existing Condition, these plant associations do not encompass large enough areas to analyze them individually. The proposed activities are predicted to assist restoration activities as described above.

Other Important Vegetation Communities

Mountain Mahogany Restoration

Proposed activities are the same for alternatives 2 and 3, therefore the effects would be the same.



Figure 16. Older mountain mahogany being shaded by ponderosa pine and young pine encroaching

Aspen Restoration

Proposed activities for aspen restoration are the same for alternatives 2 and 3, therefore the effects would be the same.

Big Game Winter Range

Slightly fewer acres are proposed for treatment in alternative 3 as compared to alternative 2, therefore expected effects would be slightly reduced.

Plant association groups included in the proposed activities within big game winter range includes 220 acres of Warm Dry Upland Forest, 115 acres of Hot Moist Upland Woodland, and 445 acres of Hot Dry Upland Forest.

Shrub Steppe Restoration

Proposed silviculture activities for shrub steppe restoration are the same for alternatives 2 and 3, therefore the effects would be the same. In units located outside of the Malheur River Inventoried Roadless Area, prescribed burning would decrease the number of conifer seedlings reaching maturity.

Activities are proposed in parts of the following plant association groups: approximately 380 acres in Hot Dry Upland Forest, 870 acres in Warm Dry Upland Forest, 90 acres in Hot Dry Upland Woodland, and 510 acres in Hot Moist Upland Woodland.

Disturbance Processes

When compared to alternative 1 (no action), alternative 3 would decrease stand densities and the proportion of late seral species across the planning area, but to a slightly lesser extent than alternative 2. This would decrease the risk of insect outbreaks of mountain pine beetle and western pine beetle. It would also decrease the effects of mistletoe and Annosus root disease. Mechanical treatments and prescribed burning are designed to develop forest structure that would have been developed across the landscape given historical fire regimes in the Cliff Knox planning area. Where fires burned very frequently with low intensity, stands have been prescribed treatments that thin from below to raise the canopy base height and increase the average diameter at breast height of the stand and leave predominantly early seral species.

Direct and Indirect Effects – Prescribed Burning and Unplanned Ignitions

The direct and indirect effects of prescribed burning have been discussed in the Silviculture Treatments section because these treatments were modeled together using the FS Veg Spatial Data Analyzer model and together they affect stand structure, density, and species composition.

Direct and Indirect Effects – Road Activities

The direct and indirect effects of road activities to forest vegetation would be expected to be the same for alternatives 2 and 3.

Direct and Indirect Effects – Strategic Road Treatments

Strategic roads treatments would be the same as described under alternative 2, with less acres proposed and a narrower, 100-foot buffer along strategic roads.

Direct and Indirect Effects – Insect and Disease Harvest

Proposed activities are the same for alternatives 2 and 3, therefore the effects would be the same.

Cumulative Effects

The effects from past practices which include timber harvesting, fire suppression, grazing, wildfire, and planting have created predominantly young, overstocked stands. Alternative 3 would use mechanical methods to treat approximately 26,400 acres and prescribed burning in approximately 32,970 acres. These treatments would reduce stand density and shift structure of the treated stands in predominantly mid-successional and older forest stands in all of plant association groups in the planning area. Native grasses and browse species will be seeded or planted after treatment to help improve forage in Big Game Winter Range. Untreated stands would continue on the current trajectory as defined in alternative 1 (no action).

The actions within the Cliff Knox planning area, as well as past, ongoing, and reasonably foreseeable actions described earlier would cumulatively have an effect on the Bluebucket Creek and Cliff Creek-Malheur River subwatersheds (see Cliff Knox Project Final Environmental Impact Statement, Appendix D – Past, Ongoing and Reasonably Foreseeable Actions). These actions would reduce stand density, shift species composition to a larger proportion of early seral species and move stand structure towards the historical range of variability to decrease the risk of large-scale, stand-replacement fire and epidemic insect outbreaks in the Malheur River drainage where it flows through National Forest System managed lands in the southeastern area of the Malheur National Forest. For more discussion regarding the cumulative effects to stand structure within the Malheur River drainage refer to Cliff Knox Project Final Environmental Impact Statement, chapter 3, Evaluation of Proposed Forest Plan Amendments section. Together, these projects would mechanically thin approximately 72 percent of the forest or woodland areas and prescribe burn 88 percent of the cumulative effects area over an approximate 25-year time period.

Compliance with Malheur Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

Malheur Forest Plan

Alternative 1 does not propose any management actions but allows the planning area to continue growing at its current trajectory. This alternative does not meet Malheur Forest Plan Forest goals #24-26 to provide a sustained flow of timber, provide and utilize wood fiber in a cost-effective manner, and provide an economic return to the public. Malheur Forest Plan standards for timber harvest, reforestation, and stand

improvement (standards #89-115) and the Regional Forester's Eastside Forest Plan Amendment 2 do not apply to this alternative because no management actions would be proposed.

- Alternatives 2 and 3 propose commercial thinning, noncommercial thinning, and small diameter thinning (including potential biomass utilization and removal of post and pole material). These alternatives meet Forest Goals #24-26 within current management direction. Silvicultural examinations were completed through formal timber stand exams in 1992-1993, 1998, 2001, 2006, and 2015-2016 and walk-throughs in 2016-2017. A draft prescription has been prepared, and would be finalized before implementing any silvicultural treatment (USDA Forest Service 1990, Forest-wide standard 94, page IV-37) Logging and post-sale operations would be restricted where necessary to protect roads, soil, water, deer and elk winter and summer range, and calving and fawning areas (see Cliff Knox Final Environmental Impact Statement, Appendix C – Project Design Criteria) (USDA Forest Service 1990, Forest-wide standard 104, page IV-38).
- Where timber management practices create firewood, preference would be given to public demand for firewood (USDA Forest Service 1990, Forest-wide standard 114, page IV-38).

Malheur Forest Plan Cover Amendment

A forest plan amendment to reduce cover in the Bluebucket and Cliff Creek – Malheur River subwatershed summer and winter range is required to authorize proposed silviculture and fuels treatments for alternatives 2 and 3. Cover requirements (satisfactory and marginal cover) are not compatible with historical range of variability. Historical conditions and fire return intervals favored large blocks of old forest single stratum with canopy closure too low to support large blocks of satisfactory or marginal cover. Under historical conditions, cover percentages would be inherently low, below Forest Plan standards and guidelines. Much of the analysis area typifies this condition; about 80 percent of the analysis area is in the Hot Dry and Warm Dry plant association groups.

Harvest treatments would occur primarily in Warm Dry and Hot Dry plant association groups. These stands are considered outside historical range of variability for density and structure. They are overstocked and unsustainable at current densities. Without treatment, they are at high risk of severe fire effects, insect caused mortality, or density induced mortality. Any of these uncharacteristic disturbance events would result in further reduction of cover within these stands.

Bluebucket Creek and Cliff Creek-Malheur River subwatersheds cover an area that represents a transition between forest and grasslands. These transition zones would have historically been less densely forested and would not have provided cover at Forest Plan standards levels. Approximately 60 percent of Bluebucket Creek subwatershed lies within winter range, where conifers have encroached into areas that have historically been browse species. Approximately 5 percent of the Cliff Creek-Malheur River subwatershed is within the winter range.

Both action alternatives would maintain the overall habitat effectiveness for each subwatershed in summer and winter range at or above Malheur Forest Plan standards; however, the alternatives would not maintain satisfactory or marginal cover to forest plan standards. Proposed thinning and prescribed burning would transition much of the project area toward more open shrub steppe and grassland habitats. Under the action alternatives, restoring the historical range of variability would mean that cover would be reduced, and forage increased.

Eastside Screens Background

The 1995 Regional Forester's Forest Plan Amendment 2, also known as the "Eastside Screens" amended the Malheur Forest Plan and continues to guide forest management. Under a more recent analysis, the

Forest Service evaluated alternatives to the interim wildlife standard of the Eastside Screens that limits harvest of trees greater than 21 inches for the Umatilla, Wallowa-Whitman, Malheur, Ochoco, Deschutes, and the Fremont-Winema National Forests. The decision associated with this analysis, called Forest Management Direction for Large Diameter Trees in Eastern Oregon and southwestern Washington (<https://www.fs.usda.gov/project/?project=58050>) was signed on January 15th, 2021. This amended the Eastside Screens by replacing the 21-inch standard with a guideline that emphasizes recruitment of old trees and large trees. Old trees are defined as having morphological characteristics that suggest an age greater than or equal to 150 years. Large trees are defined as grand fir and white fir greater than or equal to 30 inches diameter at breast height or trees of any other species greater than or equal to 21 inches diameter at breast height.

The decision implements an Old Tree and Large Tree Guideline with Adaptive Management. The intent of the guideline is to: “Maintain and increase old and late structure forest. Favor fire tolerant species where appropriate.” The new guideline replaces section d (2) of the interim wildlife standard Scenario A, where one or both of the late and old structural stages falls below historical range of variability in a particular biophysical environment. In dry forests across the Cliff Knox planning area (Warm Dry and Hot Dry plant association groups) there is less old forest single stratum than was present historically, therefore the Cliff Knox Project falls under Scenario A.

The Cliff Knox Project is not consistent with every component of the amended Eastside Screens. The following sections describe where the project is consistent with the amended Eastside Screens, and where a forest plan amendment is needed because the project is not consistent with the amended Eastside Screens.

Where the Cliff Knox Project is Consistent with Eastside Screens

Removal of Young Large Trees

Under alternatives 2 and 3, young (less than 150 years old), relatively large (greater than or equal to 21 inches diameter at breast height) conifer trees would be removed from approximately 120 acres in aspen stands and from 290 acres in mountain mahogany stands. No conifer trees that exhibit old tree characteristics (Van Pelt 2008, Johnston and Lindsay, in revision) would be harvested. While some young, large trees would be removed to meet unique habitat restoration goals, they represent 2.2 and 2.4 percent of the total proposed commercial thinning in alternative 2 (18,710 acres) and alternative 3 (16,580 acres), respectively. Where young, large conifer trees would be removed there would be no loss of late and old forest structure. The proposed action would restore the ecosystem structure and function of aspen and mountain mahogany stands by shifting the tree species composition toward the ecologically desired mix. Encroaching young conifers would be removed, reducing the risk of future insect outbreaks and uncharacteristic wildfire, while also restoring habitats for historically present plant communities and wildlife habitat. The action alternatives would develop stands more resilient to natural disturbances such as insects, disease, and wildfire.

Aspen and mountain mahogany stands are unique habitats that are sometimes geographically separate from upland forest stands and sometimes found as smaller inclusions within upland forest stands. For this project, these stands were included within the upland forest historical range of variability analysis. Stands proposed for aspen and mountain mahogany treatment are outside of late and old structure, and therefore, were considered to fall under the amended guideline (see above).

The action alternatives are consistent with the intent of the updated Eastside Screens, as amended by the Old and Large Tree Guideline on a project level scale. The planning area is an appropriate size to conduct a historical range of variability analysis (Powell 2012) and project wide, late and old structure stand

components would be maintained and/or enhanced in stands subject to timber harvest as much as possible by adhering to the following plan components:

- No conifer trees that exhibit old tree characteristics (Van Pelt 2008, Johnston and Lindsay, in revision) would be harvested,
- large, fire tolerant species would be favored where appropriate,
- appropriate species composition for biophysical environment, topographical position, stand density, historical diameter distributions, and spatial arrangements within stands and across the landscape are considered in order to develop stands that are resistant and resilient to disturbance,
- vegetative structure is manipulated in a manner that moves it towards late and old structural conditions as appropriate to meet historic range of variability, and
- open, park-like stand conditions are maintained where they occurred historically.

Late and Old Structure

The action alternatives propose thinning in late and old structure stands consistent with the Eastside Screens, standard 6(d)(1) which allows treatment to move one type of late forest “into the late and old structure stage that is deficit if this meets historical conditions.” In dry forests across the Cliff Knox planning area (Warm Dry and Hot Dry plant association groups) there is less old forest single stratum and more old forest multi-strata than was present historically (less late forest with open canopy and more with closed canopy). Alternative 2 would thin approximately 6,450 acres of old forest multi-strata to convert it to old forest single stratum (4,500 acres of commercial and small diameter thinning, 1,000 acres of small diameter thinning, and 950 acres of noncommercial thinning). Alternative 3 would thin approximately 6,000 acres of old forest multi-strata to convert it to old forest single stratum (4,030 acres of commercial and small diameter thinning, 1,360 acres of small diameter thinning, and 620 acres of noncommercial thinning). In dry forest aspen stands, alternatives 2 and 3 would thin approximately 90 acres of old forest multi-strata and would convert it to old forest single stratum. No old trees (Van Pelt 2008, Johnston and Lindsay, in revision) or large trees as defined by the amended Eastside Screens are proposed for removal from these stands.

Modeling indicates the action alternatives would move old forest single stratum within or just above the historical range and old forest multi-strata to within the historical range in dry forests (Warm Dry and Hot Dry plant association groups). These dry forests make up 98% of the upland forested area within the Cliff Knox planning area.

Where the Cliff Knox Project is Not Consistent with the Eastside Screens

Harvest Within Late and Old Structure Stands

Alternatives 2 and 3 would require a forest plan amendment to the Eastside Screens, standard 6(d), scenario A which does “not allow timber sale harvest activities to occur within LOS [late and old structure] stages that are below HRV [historical range of variability].” Old forest single stratum within the Cliff Knox planning area is below the historical range of variability and restoration treatments are proposed within these stands to promote older, larger trees. There has been an increasing trend of both younger and shade-tolerant trees growing in the understory which has increased the risk of tree mortality to old ponderosa pine and western larch due to resource competition and stress, insect attacks, and uncharacteristic wildfire. Stand densities and multi-layered canopies have also increased.

Thinning in late forest single stratum is proposed in both action alternatives where stands are considered above management zone (high tree density) and stands would continue to meet late and old structure definitions after treatment. Alternative 2 would harvest approximately 900 acres of late forest single stratum (800 acres of commercial and small diameter thinning, and 100 acres of small diameter thinning) in the Warm Dry and Hot Dry plant association groups, including five acres of aspen restoration. Alternative 3 would harvest the same 900 acres of late forest single stratum, using slightly less commercial and small diameter thinning (710 acres) and slightly smaller diameter thinning (190 acres). Thinning would promote healthy late and old forest structure and no removal of old trees (Van Pelt 2008) or large trees as defined by the 2021 amended Eastside Screens is proposed (Johnston and Lindsay, in revision).

Not Maintain Connectivity

Alternatives 2 and 3 would require a forest plan amendment to the Eastside Screens, standard 6(d)(3)(a). Connectivity between all late and old structure stands and designated old growth habitats (management area 13) is required by the Eastside Screens. However, there are many instances of late and old structure stands that are islands of timber in the middle of open meadow areas within the Cliff Knox planning area. These cannot be physically connected to any other late and old stands; therefore, the action alternatives require a forest plan amendment. Wildlife connectivity corridors would be designated between all management area 13 and some late and old structure stands within the planning area as well as to these same stand types in adjacent watersheds; however, connectivity would not be provided in all cases.

Other Relevant Mandatory Disclosures

There are no anticipated long-term significance factors from the proposed action since forest vegetation remains renewable as long as the soil productivity is maintained. There may be short-term losses of growth related to soil compaction from new landings, temporary roads, and skid trails. Compaction would be kept below 20 percent of the forested area, and growth reduction on compacted ground would be about 15 percent. This would result in a total maximum growth loss of approximately three percent per year of the growth potential until the compaction gradually diminished (in about 50 years). These areas would be rehabilitated after use, but there would be a lag in reforestation and growth since the sites are impacted more heavily than the surrounding forestland.

Monitoring Recommendations

Monitoring for forest vegetation would include monitoring for timber harvest, precommercial treatments, regeneration, and prescribed burning. Monitoring for commercial harvest would include monitoring the timber marking completed by Forest Service marking crews to ensure proper leave tree composition and density are maintained. This would be conducted through silvicultural personnel measuring variable radius plots for select units. It would also include monitoring of any designation by prescription harvesting completed by contractors to ensure silvicultural objectives are met and contract specifications are followed.

Monitoring of precommercial treatments includes monitoring contract compliance for precommercial thinning, fuels treatments, biomass removal, post and pole removal, or a combination of the two, as well as monitoring Forest Service crews completing this work to ensure silvicultural objectives are met. Monitoring for regeneration includes monitoring planting contracts to ensure contractors meet specifications and completing first- and third- year stocking surveys for planted units. Prescribed burning would be visually monitored to ensure that widespread mortality levels do not exceed mortality limits described in the Silviculture Prescription directly after burning. Mortality would also be assessed several years after burning to determine trends in mortality and the apparent causes of those trends.

Monitoring of aspen recovery treatments includes monitoring of post-activity sprouting and relevant browse damage. Areas left unfenced would be monitored for overuse and would have an exclosure fence built within three to five years if deemed necessary for aspen recovery.

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