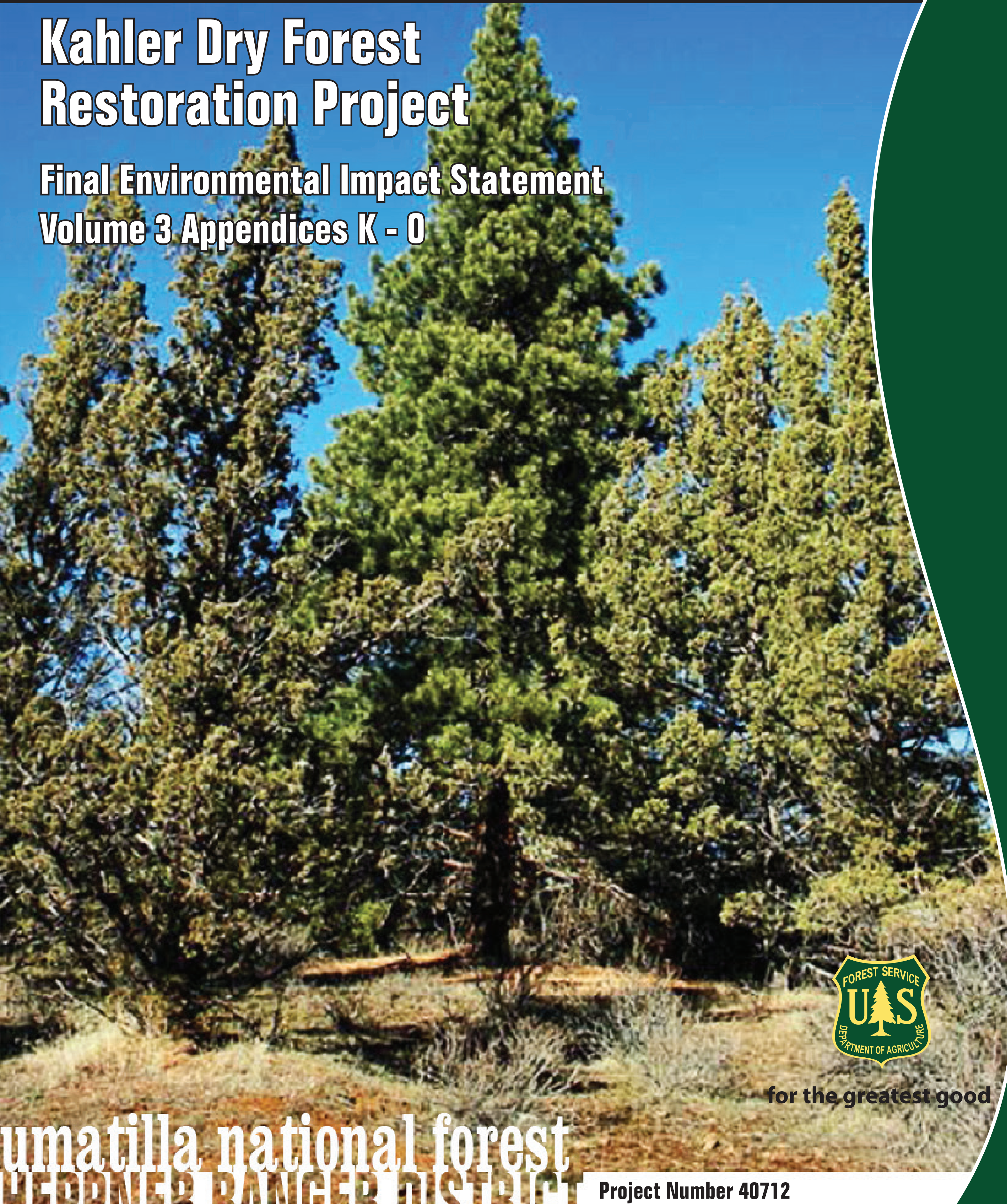
United States Department of Agriculture

Kahler Dry Forest Restoration Project

Final Environmental Impact Statement
Volume 3 Appendices K - O



for the greatest good

umatilla national forest
HEPPNER RANGER DISTRICT

Project Number 40712
December 2015

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Soils Report

Kahler Dry Forest Restoration Project

Soils Report

Prepared by:

Name: Jim Archuleta
Title: Forest Soil Scientist

for:

Heppner Ranger District
Umatilla National Forest

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Introduction

This report will focus on the soil resource for the proposed Kahler Dry Forest Restoration Project. The report will detail the specific soils mapped within the activity area, their limitations, and offer methods that may allow for mitigation of limiting characteristics for a given soil or activity unit.

This analysis will be conducted for ground disturbing activities. Depending upon erosion & sediment findings, this analysis will limit to activity areas or methods proposed.

FSM 2520 R-6 Supplement 2500-98-1 provides direction for the management of soils within activity areas. Umatilla NF (LRMP) also has the goal to plan and conduct land management activities so that reductions of soil productivity potential caused by detrimental compaction, displacement, puddling and severe burning are minimized. The goals within the LRMP state that a minimum of 80% (<20% detriment impacts) of the activity area needs to be retained in a condition of acceptable productivity potential.

This analysis utilizes the soil mapping from the Terrestrial Ecosystem Unit Inventory (TEUI) currently being completed on the Umatilla NF. A complete list of relevant mapping units is listed in the appendix of this document. While the TEUI for the Umatilla is unpublished, the area containing the Kalher project area had been completed previously, by the soil survey contractor.

While the soil resource does not have a direct relationship to the purpose and need of the project, there is a concern that the projects activities will influence the soil productivity and create unintended consequences to the productivity of a stand in the future. Specific to that are the following Kahler Issues to be examined in this analysis:

Issue 3: Use of temporary roads and reopening of existing closed roads has the potential to increase sedimentation.

Differences in alternatives would be measured by:

1. Miles (acres) of temporary roads used and miles of system road use.
2. Miles (acres) of temporary roads before and after harvest.
3. Miles of closed system roads and temporary roads used in RHCAs

Issue 4 Mechanical Treatments in Class 4 RHCA's could increase sedimentation.

Differences in alternatives would be measured by:

1. Total acres proposed for treatment within RHCA's.
2. Acres of mechanical treatments proposed within RHCA's

Resource Indicators and Measures

The Umatilla NF LRMP has soil productivity goals that are used as indicator of change. The LRMP directs that land management projects will:

Table 1: Resource indicators and Measures for assessing effects

Resource Element	Resource Indicator	Measure	Used to address: P/N, or key issue?	Source (LRMP S/G; law or policy, BMPs, etc.)?
Slope Stability	Landslide or other movement in proposed activity unit	Mapped area of unstable acres in proposal	No	LRMP, FSM, Multi-Use Sustainable Yield Act
Soil Productivity (DSC)	>80% acceptable productivity potential	<20% Increase in volcanic soil Bulk Density (Db)	Yes (Issue 3 & 4)	
		<15% Increase in non-volcanic soil Bulk Density (Db)		
		< 50% top soil loss within 100 sq. ft.		
		Mineral soil altered from burning and charring		
Soil Productivity	Erosion loss to soil productivity or change in water quality	Loss of surface soil		
Water Quality		Change in water quality		

Methodology

Remote Data – Soil Productivity (Erosion & Sediment) and Stability

First a query was done of the Terrestrial Ecosystem Unit Inventory (TEUI) soil survey data to determine the types of soils present within the planning area. These soils have been previously mapped under contract with the Blue Mountain TEUI. This mapping is inspected by the Forest Service and NRCS as it contract task orders are completed and the resulting survey is commensurate with NRCS county soil surveys. Some of the taxonomic information (texture) was used in the WEPP[1] (Elliott & Robichaud, 2001) erosion analysis; along with estimated vegetation data. The erosion analysis was conducted to determine if the proposed activities would create a risk to either soil productivity or water quality (sediment). Analysis was done for all mapped soil textures in the project area (Loam, Silt Loam and Clay Loam). Lastly the TEUI is mapped to such detail that unstable locations can be eliminated, no units were altered by this stability analysis.

Remote Data – Soil Productivity Influenced by Detrimental Soil Conditions (DSC)

To provide an understanding of soil productivity within proposed units, and how past activities may have influenced the soil resource; remote observations were made to identify legacy impacts. These observations began as remote sensing of historic aerial photos and contemporary aerial photographs. Areas with assumed presence of legacy equipment disturbance or a noticeable change to current vegetative cover; were digitally mapped. Because signs of equipment traffic were visible through the forest canopy using the contemporary base layer available in ARCGIS, this base layer image was used to digitize and map features to monitor (see Figure 1).

[1] WEPP – Water Erosion Prediction Program, an internet based erosion model.

Remote Data – Drought Stress Index (DSI)

Another soil analysis was a comparison of the newly drafted Drought Stress Index (DSI) within the planning area. The DSI mapping was recently generated by Region 6 of the Forest Service & Oregon State University, to help identify available soil water for vegetation on forest lands. The DSI allows a new perspective of sustainability when considering the soil resource. Soil moisture modulates the complex dynamics of the climate in the soil – vegetation system and helps to control the partitioning of moisture between inputs and outflow including runoff, evapotranspiration and flow between organisms. Thus the soil serves as a temporary storage for moisture to both flora and fauna. Plants depend on soil water to carry out critical biological processes. Plant physiology is directly linked to water availability. Insufficient water yield can lead to a water-stressed (drought) condition in the plant. Plants under these types of stress decrease both their transpiration and photosynthesis; to balance nutrient needs and water loss. Plants in a droughty location and growing at excess stocking (density) may be prone to drought stress; leaving the plants vulnerable to disease or insect attack. If a drought condition is prolonged, then plants are susceptible to internal hydraulic failure and mortality. Understanding where these locations may offer additional information to silvicultural and fire management recommendations, related to desirable stand density and species composition given unit. This mapping shows the difference between the early growing season (April, May June) and later in the year (July, August & September). This information was clipped to the project area to identify unit potential risks from climate change. While this data does not offer specific site recommendations; it is useful to understand the droughty nature of the site, when considering benefits of this thinning project.

Field Observations – Soil Productivity (Erosion & Sediment) and Stability

Observations were made early in the project for soil stability and field examinations for these features do not conflicted with completed soil mapping (TEUI). No signs of instability were observed and presence of erosion tended to be associated with localized occurrences. No areas identified as a chronic source of natural erosion that may be a source of sediment. There were some locations where overland flow could offer sediment, but due to the gentle slopes and minor scour of the exposed soil; it is assumed that this occurrence was likely within background erosion and sediment volumes.

Field Observations – Soil Productivity Influenced by Detrimental Soil Conditions (DSC)

The criteria for disturbed soil were defined by Page-Dumroese, et al 2009 & Napper et al 2009. The descriptions within the Soil Disturbance Protocol were then used to validate the presence or absence of detrimental disturbance mapped from remote sensing. This field validation was conducted by a trained crew in 2013. These observations and data collection helped to determine detrimental impact to the soil resource remaining in an impacted state and if it is to be considered to be in a detrimental condition. Observations and measurements were taken every 100 feet. The worksheet offered in Page-Dumroese, et al 2009, Appendix C-3 was adapted for data collection. The form was altered to gather data on live trees within mapped trails.

The presence (or absence), growth and development of trees in mapped trails was considered to be a surrogate for soil productivity. Soil disturbance measurements were taken in 12 by 12ft plots, along the mapped trail. Plot size was based on the average 12ft width of trails. Information gathered showed a presence or absence of tracks (ruts), berms or burned soil and the depth of the disturbance. The presence of ruts or berms is a sign of soil disturbing equipment traffic (soil molding). Since trails are expected to recover to natural soil conditions over time, it was assumed these changes in vegetation and soil structure were a signature of declining soil productivity (i.e. DSC) within the prism of these mapped features. To measure a change in soil structure or lost soil productivity each data collection point a hand shovel excavation to measure any change in the soil structure. Changes were and compared the soil structure of an undisturbed area.

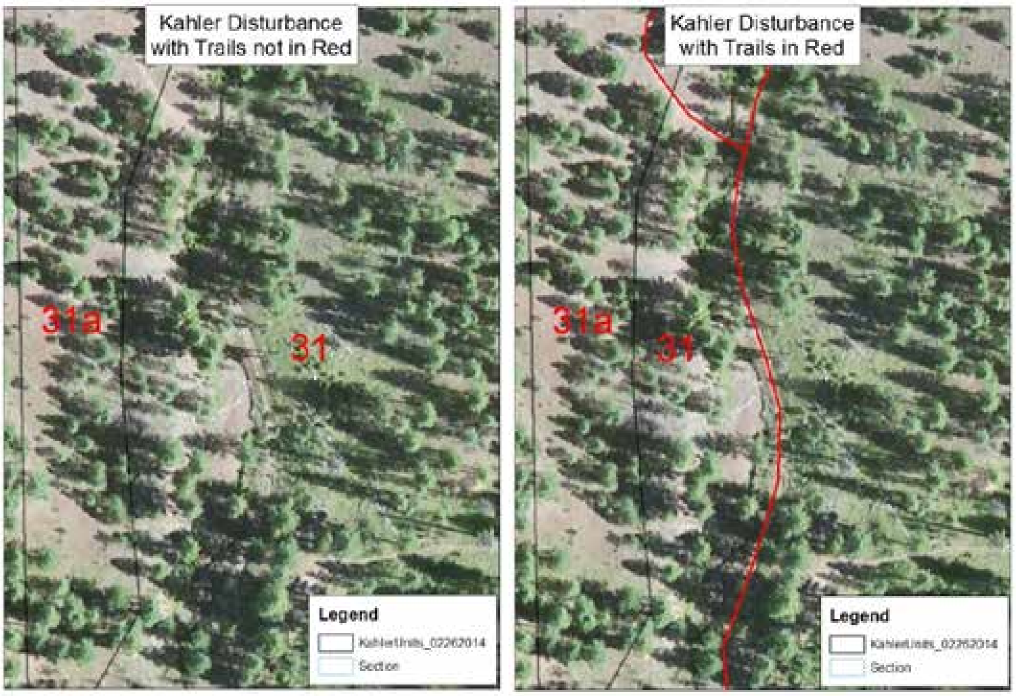

Figure 1 Photo shows units 31a & 31, Legacy trails (with double ruts) in unit 31 is seen from the lower part of the photo, traveling up to the top of the photo; where another trail enters unit 31a. Left photo does not have trails mapped, but Right photo does. This is an example of trails monitored during the summer of 2013.

Excavations were made to approximately 30 cm (12 inches) and evaluations were made for three depths; 0-10 cm (~0- 4 inch), 10-20 cm (~4-8 inch), and 20-30 cm (~8-12 inch).

Field observations – Drought Stress Index (DSI)

Since the DSI is based partly on textural data from the published Soil Resource Inventory (SRI), no additional data was collected to validate. The collection of information related to Actual Evapotranspiration (AET) and Potential Evapotranspiration (PET) is derived from regional GIS data and was not validated on the stand level.

Information Sources

The SRI and TEUI offer the taxonomic classification of mapped soils; its parent material (Geology), general landscape position (Topography), biological factors (Vegetation), climate and age. In addition to the soil forming factors the TEUI also describes the stability of a soil, its typical depth, its texture, and its drainage.

DSI data was generated from USFS Soil Resource Inventories (SRIs) at a scale of 1:63,560 were used. The DSI used the SRI information since there is not complete coverage of the TEUI at a regional scale. Calculations of in the DSI Available Water Holding Capacity (AWHC) – that soil water available for plant uptake, were determined by soil horizon based on the following formula: AWHC = (W1/3 – W15) x (Db 1/3) x Cm / 100 [2]

[2] AWHC = volume of water retained in 1 cm3 of whole soil between 1/3-bar and 15-bar tension; reported as cm/cm-1 [numerically equivalent to inches of water per inch of soil (in/in-1)]
W1/3 = weight percentage of water retained at 1/3-bar tension

Incomplete and Unavailable Information

The field data for the observed detrimental effects of previous activities did not cover every unit in the proposal and therefore should be considered incomplete information. However the information gathered (remotely and actual observations) serves as an indicator of the accuracy of the remotely sensed data. Of the data collected along the 98200ft of assumed trails, only 30,000ft (31%) was defined within DSC. In some instances the presence of a trail in the mapping was not found; there is no record of active restoration of the remotely sensed disturbance. In one of these cases, natural soil activity is thought to have restored or erased the legacy activity disturbance; due to pedoturbation.

Affected Environment

Existing Condition (Soils)

Natural development

As mentioned earlier the areas soils have been mapped with the TEUI. These taxonomic delineations result in polygons of various shapes and sizes across the landscape. Polygons are populated with either a soil consociation (single series) or soil complexes of various soil series. Some soil series have either been previously identified in another soil survey or newly identified within the TEUI mapping on the Umatilla NF. Soil complexes can have two to four soil series within a complex, the first series named in the complex is the dominant, with the remaining series placed in its place of dominance in the complex name.

In the taxonomic description for each of the soil series, there is a soil order. The importance of knowing the soil order of a soil series is the implications the soil order has to a given soils development. This soil order information offers clues to the history of a given landscape and a better picture of the landscape environmental development. Within the project, four soil orders are identified by the soils mapped in proposed units. The soil orders within the project area range from slight (Inceptisols & Andisols) to intermediate (Alfisols and Mollisols) in their degree of development (Brady & Weil. 1999). For context soil development can range from hundreds of years to thousands depending upon the competency of the parent material and the climate of the area.

As previously mentioned soil taxonomy offers a window into how the landscape may have looked long ago. For example three of the four soil orders identified can develop under a forested environment. Inceptisols (~1% of unit soils) are recently developed soils (Brady & Weil. 1999), and may form on the deposition of colluvium (rock fall). The series within the soil order of Inceptisols are mapped mostly in draws and other concave landforms and thus conform to the concept of Inceptisols development. Andisols (~6% of unit soils) are formed when there is a deposition of volcanic flow of pumice material or the deposition laden with ash and pumice, such as those found within the Kahler area. In the Kahler area it is assumed that the presence of intact over burden of ash air fall is a sign of increased productivity (Garrison-Johnston et al, 2007), when compared to non-Andic soils. Alfisols are soils associated with development under forested conditions (Brady & Weil. 1999). It should be noted that the presence of Alfisols are not part of the taxonomic description of any of the dominant soil series in the mapped complexes. The implication of this finding is Alfisols (forest developed soil) played a minor role in the forest we see today.

W15 = weight percentage of water retained at 15-bar tension
Db1/3 = bulk density of <2-mm fabric at 1/3-bar tension
Cm = rock fragment conversion factor derived from: volume moist <2-mm fabric (cm3)/volume moist whole soil (cm3)

Then there is the soil order with the largest acreage within the project area, Mollisols (~96% of unit soils). Mollisols typically form in a grassland environment; some Mollisols form under forest, but mostly in depressions (Brady & Weil. 1999). What classifies these soils as Mollisol; a dark color (Chroma of 2 or less), the presence of high organic matter content, and >50% saturation with base-forming cations Ca^{2+}, Mg^{2+}, etc. (Brady & Weil. 1999). Given the prominent expanse of the Mollisols soils mapped in the area, it is not likely these soils formed under a forest in topographic depressions. Not that trees were absent in the development of these soils; but the soil habitat may have been best described as savannah with widely spaced trees. It is not known what may have created the conditions which formed these soils, but it is very likely that fire had a role in density management that produced the areas Mollisols.

Human Influences to the Soil Resource

As mentioned in Methodology (Field Observations), there have been human caused influences that caused some change to the soil resource. Some of these influences have been recognized as having either beneficial, no effect, or detrimental effects to the soil resource.

In the past, human ignited fire could be partially responsible for stand densities consistent with Mollisol soil development. In a general sense, it is assumed that maintenance burning will beneficially consume fuels, preventing the high intensity/long duration fire that can detrimentally heat alter the soil resource. Conversely, current human suppression of fire helps to build wildland fuel loads that may create detrimental effects to the soil resource (i.e. heat altered soil). Heat altered soil is commonly associated with sterilization of the topsoil and the formation of hydrophobic layers that promote erosion and stream sediment.

Concentrated human activity on native surfaces can create effects seen as roads and trails. The most direct and recognizable influence left on the landscape is either from past harvest activity or unregulated recreation activities (see Figure 1). It has been noted by numerous authors that compaction and displacement effects associated with temporary roads and skid trail equipment traffic can detrimentally influence vegetation and their associated soil communities (Froehlich & McNabb1983,

Amaranthus et al, 1996, Bulmer et al, 2010 and Miller 2004). Often, impacts like temporary roads landings & trails do not prevent vegetation from growing seedlings, but these features can limit the opportunity of vegetation to reach maturity. Additionally if left on the landscape without Effective Ground Cover (EGC) these features can cause erosion (Lane et. al. 1988). Depending upon the impacts proximity to surface water, they could serve as sediment sources. At this time there are no observed sources of direct sediment input within the project area.

Erosion and Sediment

Baseline overland erosion and the sediment it may create were modeled with WEPP, for slopes and soil textures found within proposed harvest units. This modeling also took into account the differing soil textures & rock percent's associated dominant soils in all units; unit slopes ranges, and the EGC were also part of the variables in the modeling. To generate baseline sediment and the probability of its occurrence, the range of variables in units were populated in the model to test the greatest distance offered within the model (1200ft). This modeling showed a baseline that was low probability (0%) of sediment and low volumes of sediment (undetectable). Since this is a model and may not represent actual occurrences, the nearby Barometer Watershed report (Harris, et.al. 2007) was used to define a baseline estimates to be used with the modeled results for sediment; this soils analysis assumes that modeled estimates above 0.03t/ac will need some mitigation or avoidance measures to allow for proposed activates to be considered sustainable from the perspective of the soil resource.

Table 2: Resource Indicators and Measures for the existing condition

Resource Element	Resource Indicator	Measure	Existing Detrimental Soil Condition (ac)
Soil Stability	Soil Mass Wasting	No active areas identified	0.0
Soil Productivity	Erosion	Activity unit acres modeled >0.03t/ac	0.0
Water quantity	Sediment	Activity units that may produce >0.03t/ac	0.0
Detrimental Soil Conditions (DSC)	Change or absence in vegetation growth	Legacy trails in project area (Est 152.8 total miles) [3]	45
		Legacy trails in proposed Harvest Units (Est 45.1 total miles)[3]	13
		Legacy trails or landings in RHCA of either class 2, 3, or 4 streams (Est 19.4 total miles)[3]	6

Resource Indicator or Measure 1

Observations were made early in the project for soil stability and field examinations for these features do not conflicted with completed soil mapping (TEUI) and or add to known landslide features mapped on the Umatilla NF. Therefore this resource indicator of slope stability is not a factor in this analysis.

Resource Indicator and Measure 2

Presence of erosion was detectable, but field observations are consistent with expected sedimentation rates noted by WEPP and Harris, et.al. 2007.

Resource Indicator and Measure 3

Evidence of scour (sediment movement was recorded in the examination of streams (i.e. Class 4 identification). However it is assumed that field observations are consistent with expected sedimentation rates noted by WEPP and Harris, et.al. 2007.

Resource Indicator and Measure 4

The presence of DSC was found in association with legacy trails. It is assumed that most of these trails were left from previous harvest activities, but some may have been created from unregulated recreation in the area. Topography of the area is conducive to access for most forms of vehicles used in recreation activities. Estimates of DSC are based on the 2013 Kahler field observations; in those site visits 98200ft of trails were examined; 31% was considered to be in DSC, when using the criteria from Page-Dumroese, et al (2009).

[3] This estimate of DSC is based on Kahler field observations. Of the 98200ft of examined trails; 31% was considered to be in DSC.

Management Direction

Desired Condition - Multi-Use Sustainable Yield Act, FSM and LRMP

Multi-Use Sustained Yield Act of 1960, directs the agency to manage resources (outdoor recreation, range, timber watershed and fish) in combination that best meets the needs of the American people. Sustained yield means achieving and maintaining into perpetuity a high-level annual or regular periodic output of renewable resources without impairment of the productivity of the land.

Forest Service Manual (FSM) 2500 has the objective (FSM 2551.02) to determine if land management practices need adjustments to sustain or restore soil quality.

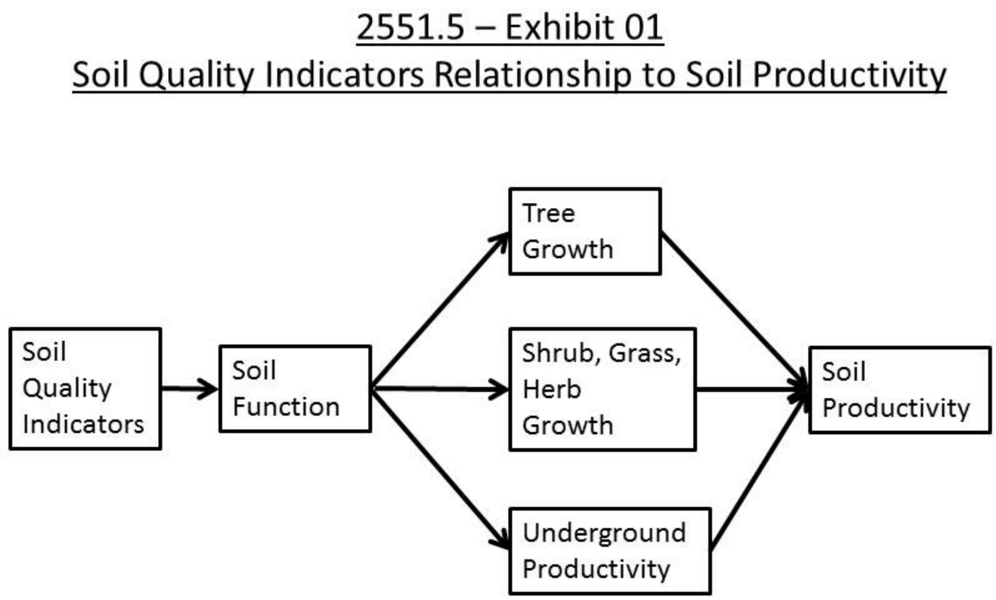

Figure 2, Flow chart copied from FSM 2550 page 16 of 20. Intended to illustrate the relationship between soil quality indicators, soil function and soil productivity. Soil quality indicators are developed to give insights as to how well the inherent soil is functioning, i.e., biologically, hydrological, carbon storage, etc.

The FSM 2551.5 further states that the use of soil quality indicators ultimate goal is to provide information on the health of the soil. For example; when an indicator (i.e. tree growth), is altered by management practices. This type of alteration to soil indicators is considered an expression of a detrimental change to the productivity of the soil resource.

The Desired Future Condition in the 1990 Forest Plan (LRMP) for water/soil is to maintain soil productivity (Forest Plan p. 4-9). The plan further states that Standards and Guidelines are to maintain a minimum of 80 percent of an activity area in a condition of acceptable productivity potential. Acceptable productivity is defined as:

- Less than 20% increase in bulk density of volcanic soil or a less than 15 percent increase in soil bulk density for other forest soils.
- Soil disturbance of less than 50 percent of the topsoil humus enriched A1 and or AC horizons from an area 100 sq. ft. (i.e. 5ft by 20ft)
  - Molding of the soil in vehicle tracks that area rutted to a depth less than 6 inches.

- Severely burned soil with the top layer of mineral soil altered in color (usually to red) and the next ½ inch blackened from organic matter charring.
- Plan and conduct land management activities so that soil loss from surface erosion and mass wasting, caused by activities will not result in an unacceptable reduction in soil productivity or water quality.
- Management activities shall be designed and implemented to retain sufficient ground vegetation and organic matter to maintain long-term soil and site productivity.
- Active slump and landslide area are considered unavailable for road construction. Areas with known landslide potential and lake sediments require special transportation planning and design, layout preconstruction, construction and maintenance techniques.

Environmental Consequences

Alternative 1 – No Action

Direct and Indirect Effects

Table 3: Resource Indicators and Measures (RIM) for Alternative 1.

Resource Element	Resource Indicator	Measure	Existing DSC Effects mi (ac) (Alt. 1)	Wildfire Influenced Effects on Existing DSC mi (ac) (Alt. 1)
1. Soil Stability	Soil Mass Wasting	No active areas identified	0.0	0.0
2. Soil Productivity	Erosion	Activity unit acres modeled >0.03t/ac	0.0	18/26
3. Water quantity	Sediment	Activity units that may produce >0.03t/ac	0.0	27/39
4. Detrimental Soil Conditions (DSC)	Change or absence in vegetation growth	Legacy trails in project area[4]	152 (45)	152 (45)
		Legacy trails in proposed Harvest Units[4]	13 (20)	45 (65)
		Legacy trails in current RHCA (class 2, 3, or 4 streams)[4]	6 (9)	20 (30)
		Legacy trails in area influenced by wildfire (400ft from streams)[4]	0 (0)	18 (26)

Resource Indicator and Measure 1

Soil mass movement was not identified in the area or as a risk that should play a role in any of the proposed activity units, therefore, it is assumed that mass movement will not influence the proposed alternative in the recent past, nor will it play a role in this alternative or the foreseeable future.

[4] While the presence of some DSC is known to increase sediment, it is currently covered with adequate EGC to limit sediment above background levels.

Resource Indicator and Measure 2

If the project area were to continue unchanged by further disturbance from humans or natural events; it would remain on its current soil developmental trajectory with no direct change to the resource indicator of erosion. This assessment is made despite the presence of DSC in the form of legacy trials assumed to be detrimentally impacted from previous harvest. While the presence of some DSC is known to increase sediment, it is currently covered with adequate EGC to limit erosion above background levels.

Due to the presence if DSC (legacy trails) erosion could have be indirect effect to this alternative. Indirect effects would occur with the loss of EGC from disturbance (wildfire). Given the effects of past wildfire occurrence in the project area (1996 Wheeler Point Fire), it is in the reasonably foreseeable future that similar effects can happen. This alternative does not reduce fuel loads, thus the wildland fire assumptions in the alternative are for High Severity Burn.

Assumptions for the WEPP runs included 30 year climate model duration, loam and silt loam soil textures, slope gradients from 10 to 60 percent, upper slope lengths of (1200ft – harvest), and (300ft to 700ft skid trails), and with cover elements of Mature Forest (100% cover), and High Severity Fire (45% cover). Additionally the cover element of skid trials was added due to the presence of existing skid trails in the proposed units; skid trails in WEPP was a cover of 10%, with a contestant surface rock content of 10%. Lower slopes (buffers) were modeled with gradients of 10 to 60 percent, lengths of 5 to 95 feet, with no treatments (Mature Forest 100%). To model the effects of wildfire buffer covers were reduced to 45% (WEPP default for High Severity Fire), soil cover of 100 percent, rock content 10 percent. Background (no action) runs were also made; with upper elements having the same variable as the lower elements to model current erosion and sediment. The inputs for each of the model runs, is listed in the appendix of this soils report.

The most productive part of the soil is often the closest to the mineral surface (Brady & Weil 1999). Erosion would either change the location of productive soil; or be a loss of soil productivity to stream sediment inputs. Additionally, it is assume that the network of legacy trails can offer means to route surface flow and sediment to streams. In an effort to understand this effect WEPP modeling added the variable off EGC loss to the harvest scenarios modeled. As with the no action alterative showed previously; just the removal of tree canopy did not have an effect.

Further modeling in the proposed activities added the potential of wildfire and DSC. This was an attempt to examine the occurrence of wildfire in all alternatives for comparison. The WEPP model inputs used first examined reflected the flattest sloped buffer; 10% slope between the trail end and stream. In the non-wildfire scenarios this condition was the least impactful model run. Loss of cover was used in the model was an assumed 10% trail cover and 45% High Severity Fire default, was used for wildfire effects in the buffer. In the modeling we see that a skid trails would not be allowed within 400ft of streams, with the occurrence of a wildfire; due to loss of Effective Ground Cover (EGC). This illustrates the importance of EGC within no equipment riparian buffers. It is assumed that all of the other DSC (>400ft from streams); 18 miles or 26 acres of trails would produce erosion which could hinder soil productivity; if the loss of cover within the riparian were lost in a wildfire event.

Resource Indicator and Measure 3

If the project area were to continue unchanged by further disturbance from humans or natural events; it would remain on its current soil developmental trajectory with no direct change to the resource indicator of sediment. This assessment is made despite the presence of DSC in the form of legacy trials assumed to be detrimentally impacted from previous harvest. While the presence of some DSC is known to increase sediment, it is currently covered with adequate EGC to limit sediment above background levels.

Further modeling in the proposed activities added the potential of wildfire and DSC. The WEPP model inputs used first reflected the flattest sloped buffer; 10% slope between the trail end and stream. In the non-wildfire scenarios this condition was the least impactful model run. Total loss of cover in the model run assumed, 10% trail cover and 45% High Severity Fire default in WEPP was used for the buffer. In the modeling we see that a 400ft buffer is needed to limit sediment loss to streams. Within the 400ft distance from streams there were 27 miles or 39 acres of trails would produce sediment that could influence the hydrology of the project areas.

Resource Indicator and Measure 4

Without human intervention there are not many cases when the soil resource can be influenced. Thus the inhibition of the growth of tree and brush (FSM 2551.5 exhibit 01) would be considered an expression of a detrimental change to the productivity of the soil resource. Within the proposed planning area there are human created trails that measure approximately152 miles of assumed trail. The highest densities of visible trails in the project area are within the Wheeler Point Salvage. These trails have appeared to have inhibited vegetation growth and type of growth. To verify this change the Soil Disturbance Monitoring Protocol was adapted to evaluate the recognized changes (Page-Dumroese, 2009). While not many of these effects seem to have been reduced over time, there is one instance where the soil restored itself.

The inhibition on plant growth seems to be related to trees and brush (with Juniper and Lodge Pole Pine being less affected); grasses, herbs and forbs in general may also have been influenced, but no measureable change was identified in the soils report. Estimates of DSC (Table 4) are based on the 2013 Kahler field observations (Table 13); in those site visits; 98,200ft of trails were examined. Of the trail sites measured, 31% was considered to be in DSC, when using the criteria from Page-Dumroese, et al (2009). That impact was used to evaluate potential impacts in units. When trails mapped were clipped to existing unit boundaries, 31% of clipped trails were calculated as DSC. Using this method it was determined that 3% DSC was the greatest DSC finding in a given unit. Therefore the DSC analysis used 3% DSC estimates for estimating existing DSC in ground based units where DSC was not measured in quality or quantity.

Cumulative Effects

Spatial and Temporal Context for Effects Analysis

Cumulative effects are not expected from Resource Indicator and Measure (RIM) 1 – Mass movement.

Cumulative effects from RIM 2 – Erosion, are expected to be localized; unless influenced by a combination of wildfire and the erosion processes exposed to high winds. Winds can transport detached soil aloft and to a new location. This would prove to be a loss to soil productivity within a proposed unit, if this occurs it is unknown if some portion of this material would end up as sediment. The potential duration of expected erosion risk would be for at least 3 years immediately following wildfire (Elliott et al 2001 and Robichaud 2000). The volumes of erosion under this risk are also influenced by the intensity and duration of precipitation events that occur during elevated erosion risk.

Cumulative effects from RIM 3 – Sediment, are expected to be small with no elevation above assumed background levels; unless like above influenced by wildfire. If wildfire takes place elevated. The potential duration of expected sediment risk would be for at least 3 years immediately following wildfire (Elliott et al 2001 and Robichaud 2000). The volumes of sediment under this risk are also influenced by the intensity and duration of precipitation events that occur during elevated sediment risk.

Cumulative effects from RIM 4 – Detrimental Soil Conditions (DSC) that assumed to be created by equipment traffic seem to be long-lived (>40 years), with an exception in Kahler Unit 14. Soil development within Kalher has some measure of vertic soil properties; this feature was recognized in unit 14. Vertic soil properties seem to have erased the presence of equipment traffic. This was found by following the GPS location of mapped DSC. Within the mapped location of the trail once exiting the vertic properties the trail was located in the mapped location. Thus it is assumed that the vertic (heave) within the soil overtime erased the legacy trail from the landscape (within the last 40 years). While this does show a restorative benefit to soils with vertic properties, it is not advisable to locate trails on these features. These soils also store a great deal of moisture from the clays that form these soils and locating equipment traffic through this soil may prove to have inputs to sediment sources; if these clays are suspended in puddles that are then allowed to route water on trails.

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

All ground disturbing activities included in the list of past, present and reasonably foreseeable activities for the Kahler project in the EA (Chapter 3) are relevant to cumulative effects analysis for DSC.

Alternative 2 – Proposed Action

Project Design Features and Mitigation Measures

Per Multi-Use Sustainable Yield Act, FSM and LRMP the following design features and mitigations will be placed on Alternative 2.

1. Use of harvest equipment will not be permitted when soils reach field capacity for moisture, to limit the potential of long-term detrimental soil disturbance (Amaranthus et al. 1996, Bulmer et al. 2010, Froehlich et al. 1983, Heninger et al, 2002, Miller et al. 2004 and Page-Dumroese et al 2009.)

2. Placement of new temporary roads will be on deep soils, if it is operationally feasible. This will allow for adequate restoration of temporary roads and over time will leave less measurable detrimental soil condition across the proposed activity units (Archuleta, 2006, 2007, 2008). Lithosol (scab flats) and meadows will not be used for landings and skid trails; unless no other location is practical. If use is necessary disturbance will be kept to a minimum amount of the area, preferably at the edges of these features.

3. Within commercial harvest units, no harvest or heavy equipment will leave designated roads or trails, to limit the potential of detrimental soil disturbance. In the non-commercial thinning units, mechanical thinning equipment may be used provided that equipment that exceeds 7 PSI is not allowed to travel over the same path more than once. Some noncommercial thinning will be by sawyers (hand only).

A full list of BMPs, some with criteria driven by soil resource concerns have been incorporated within the EIS.

Direct and Indirect Effects

Table 4: Resource Indicators and Measures (RIM) for Alternative 2

Resource Element	Resource Indicator	Measure	Existing DSC Effects mi (ac) (Alt. 2)	Wildfire Influenced Effects on Existing DSC mi (ac) (Alt. 2)
1. Soil Stability	Soil Mass Wasting	No active areas identified	0.0	0.0
2. Soil Productivity	Erosion	Activity unit acres modeled >0.03t/ac	0.0	0/0
3. Water quantity	Sediment	Activity units that may produce >0.03t/ac	0.0	0/0
4. Detrimental Soil Conditions (DSC)	Change or absence in vegetation growth	Legacy trails in project area[5]	142 (38)	142 (38)
		Legacy trails in proposed Harvest Units[4]	9 (13)	9 (13)
		Legacy trails in current RHCA (class 2, 3, or 4 streams)[4]	6 (9)	6 (9)
		Legacy trails in area influenced by wildfire (400ft from streams)[4]	0 (0)	0 (0)

Resource Indicator and Measure 1

Soil mass movement was not identified in the area or as a risk that should play a role in any of the proposed activity units, therefore, it is assumed that mass movement will not influence the proposed alternative in the recent past, nor will it play a role in this alternative or the foreseeable future.

Resource Indicator and Measure 2

In Alternative 2 that will have some effect on Soil Productivity (Erosion): harvest (Ground Based, Skyline, Helicopter and Prescribed Burning). Each of these methods has an expected impact to the DSC (Reeves, 2011, Archuleta, 1997 & 1999, Siskiyou NF, 1997 and Bennett, 1982), which can influence erosion.

As mentioned in the existing condition discussion, there are existing DSC within activity areas from past activity. Some of the proposed activity impacts (Alt 2) will overlap with proposed temporary roads. During the implementation of activates, there will be some elevation of risk to erosion. However BMPs (erosion control) will mitigate or diminish; if not all most of the short term effects from erosion. To estimate this risk the WEPP model was used.

While the WEPP modeling did not take slope profiles to input into the model, a range of slope characteristics were identified in GIS that cover the range of slope conditions found within the proposed units. WEPP uses two elements in the model. The upper element represents the disturbance activity (i.e. harvest), and a low element which represents the sediment buffer to a waterway. In the model the steepest slopes found in the units were used to represent the worst case scenario for erosion modeling (upper

[5] While the presence of some DSC is known to increase sediment, it is currently covered with adequate EGC to limit sediment above background levels.

element 60%, lower element 40% to 60%). To display differences in effect to the RHCA treatments, a variety of buffer widths were used in the model (Table 12).

Results of the model runs for harvest and burning treatments showed that average annual erosion was very low (0.0044t/ac). The harvest example was using no disturbance other than removal of EGC. This is not to say under the extreme conditions (high precipitation, poor EGC left in place, or unplanned equipment traffic), erosion could not occur above background levels.

Based on the model runs and assumed background levels, it was decided that the harvest and prescribed burning would produce less sediment delivery than a high severity wildfire of similar size, so the Kahler harvest and burning in RHCA would be justified and no soils specific Design Criteria is recommended based on canopy removal.

When the WEPP model used the criteria to examine skid trails there was elevated erosion, so design criteria was developed. This information was used to limit the length of trails (225ft and 600ft); acceptable skidding lengths are based on slope breaks and are defined in the Design Criteria of this EIS.

The previously mentioned trails that will be used in the proposed activity as temporary roads will be subject to restoration (obliteration) of the DSC. As long as the proposed activity is allowed to use legacy trails, they can be eliminated by contract provision of a timber sales.

Resource Indicator and Measure 3

In Alternative 2 there will be some effect to the Resource element of Water Quality (Sediment). Mentioned in the existing condition discussion there is existing DSC from past activities. Each of these methods has an expected impact to the DSC (Reeves, 2011, Archuleta, 1997 & 1999, Siskiyou NF, 1997 and Bennett, 1982), which can influence sediment. Some of the proposed activity impacts will overlap with proposed temporary roads. During the implementation of activates, there will be some elevation of risk to erosion. However BMPs (sediment) will mitigate or diminish; most if not all, short term effects from erosion. To estimate this sediment risk the WEPP model was used the two soil textures of loam and silt loam are the only soil textures that were mapped within the proposed units.

Results of the model runs for harvest and burning treatments showed that average annual sediment was below background, <0.03t/ac (Harris, et.al. 2007). This means that harvest of trees (in or out of the RHCA), to the prescribed canopy density (>40% cover); would not show a measureable effect from sediment. This is not to say all proposed activities (in or out of the RHCA) would not have an effect to sediment (Table 12). Since skid trails are often extremely deficient of EGC, additional modeling was done to examine skid trails. Skid trails (a yarding method) are the one example when sediment could rise above background levels. A cover of 10% (skid trails) was used in WEPP model runs (Table 12). When skidding of trees was examined in relationship to the RHCA thinning, unlike the felling of trees; it was determined that a buffer was indeed needed to minimize the risk of sediment to streams. An additional mitigation from the WEPP analysis would be to retain at up to 30% EGC within the skid trail prism, especially with units that contain clay loam soils. This effect has a direct bearing in units 3b, 4, 4a, 44b, 5, 6, 7, 7a, 8, 11b, 12a, 13, 14, 15, 16, 17, 18b, 19, 21b, 23, 23b, 23c, 24, 25, 27a, 27b, 27c, 28a, 31, 31b, 35, 98 and 212. In these units it is recommended that skid trails adjacent to or draining toward RHCA will have 30% EGC.

Based on the model runs and assumed background levels, it was assumed that the harvest and prescribed burning would produce less sediment delivery than a high severity wildfire of similar size. The analysis thereby shows that the Kahler harvest and burning in RHCA would be justified and no Design Criteria is recommended based on canopy removal. Skid trails however may not be allowed to get closer than 75ft from a stream in RHCA treatments; in cases of increased slopes that buffer can be 100ft (Table 11). With all other streams the normal buffer distances will still apply, for both harvest and equipment traffic.

Some benefits to the sediment are expected from this alternative. As previously mentioned there are existing legacy trails. Some of these trails will be used as temporary roads in the project and subject to removal per the forest plan. Additionally since the temporary roads are used in the timber sale itself, it is allowable that under contract provisions of the timber sale they can be obliterated. These obliterated roads are considered restoration of the soil resource; in the event of a wildfire or similar defoliating event, the obliterated road will not offer a means of sediment inputs.

Resource Indicator and Measure 4

In Alternative 2 there will be some effect to Detrimental Soil Conditions (DSC). Mentioned in the existing condition discussion there is existing DSC from past activities. Each of these methods has an expected impact to the DSC (Reeves, 2011, Archuleta, 1997 & 1999, Siskiyou NF, 1997 and Bennett, 1982), which can influence sediment.

While Reeves offers a comprehensive list of expected detrimental effects, it appears these estimates may underestimate effects if certain conditions are present or absent. To offer an expected DSC that may be relevant to proposed activities and conditions present the following were used in DSC calculations; Ground Based 10% (Archuleta, 1997 & 1999), Skyline 5%, Helicopter 1% (Siskiyou NF, 1997), Prescribed Burning 1% (Bennett, 1982). Additionally, there may be some use of ground based equipment to pre-bunch helicopter loads to improve efficiency of helicopter logging. This activity will be done with a single pass to limit DSC described by Han (2006); the soil moisture for this activity will also be limited to dry conditions as a further mitigation.

Understanding the benefiting opportunities from fuel loading (slash) with yarding method may be an important factor to consider in the analysis. If harvest in a unit occurs before or as it transitions from moist to dry soil conditions; equipment may need to ride on slash to minimize DSC.

To illustrate how important this may be to the Kahler project, Figure 3 is offered as an example. In this harvest on the Umpqua NF (Flat IRTC)[6]; shows how some ground based yarding equipment is designed to float on slash, benefiting the soil resource; minimizing the detrimental effects of compaction and displacement. Slash was available for both sections, but the yarding systems required the harvester to use slash to minimize soil disturbance and the skidder to push it out of the way. The actual trails marked within the harvester section do not represent all trails used. The map only represents those trails needing to be obliterated by the harvest contractor in that IRTC (stewardship) project. There were “ghost trails” which registered no DSC disturbance (between mapped trails) used in the harvester section. These unmapped trails used a slash mats (>1 foot) to float equipment; leaving no measureable detrimental effects in their wake. Another reason that trails were around 80 to 100ft apart; the trees being harvested from “ghost trails” were directional felled to the mapped trails from unmapped trails. This allowed for the “ghost trail” to be used once in a single direction, effectively making a single pass and limiting DSC effects (Han, 2006)

The comparison in Figure 3 is important for the Kahler analysis; it is assumed that the opportunity to mitigate equipment disturbance with slash may not be an option in many Kahler project units. Therefore if harvester logging is used during implementation; it must occur after the soil has transitioned from moist to dry soil conditions. If this design criterion is not followed, the resulting effect will likely be similar to the skidder disturbance seen in Figure 3.

[6] Impacts were GPS located and later subsoiled to restore acceptable soil productivity to the entire unit

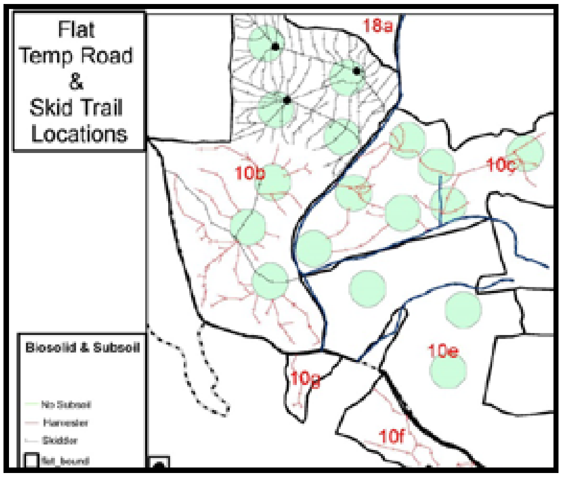

Figure 3 Cropped map of Flat IRTC monitoring. Umpqua NF, 2009.

The elements of DSC are currently present in proposed units and will change in some areas by proposed activities. This change will take place mostly in association with the overlap of legacy trails and new temporary roads. Where this overlap occurs it is expected that there will an overall decrease in DSC for that segment of legacy trail.

Within the proposed planning area there are human created trails that measure approximately152 miles of assumed trail. The highest densities of visible trails in the project area are within the Wheeler Point Salvage units. These trails have appeared to have inhibited vegetation growth and type of plants. To verify this change the Soil Disturbance Monitoring Protocol was adapted to evaluate the recognized changes (Page-Dumroese, 2009). While not many of these effects seem to have been reduced over time, there is one instance in Unit 14, where the soil restored itself; this example is explained in the cumulative analysis section of this alternative.

The inhibition on plant growth seems to be related to trees and brush (with Juniper and Lodge Pole Pine being less affected); grasses, herbs and forbs in general may also have been influenced, but no measureable change was identified in the soils report. Estimates of DSC (Table 4) are based on the 2013 Kahler field observations (Table 13); in those site visits; 98,200ft of trails were examined. Of the trail sites measured, 31% was considered to be in DSC, when using the criteria from Page-Dumroese, et al (2009). That impact was used to evaluate potential impacts in units. When trails mapped were clipped to existing unit boundaries, 31% of clipped trails were calculated as DSC. Using this method it was determined that 3% DSC was the greatest DSC finding in a given unit. Therefore the DSC analysis used 3% DSC estimates for estimating existing DSC in ground based units where DSC was not measured in quality or quantity.

Therefore within the harvest units there is a total of 45 miles (65acres) of trail for a total of DSC (including system roads). Since only 31% of the evaluated impacts were deemed to be DSC; like alternative 1, we can assume 31% of the total DSC is a loss to the soil resource (13 miles or 20 acres). Of the legacy trails mapped in the project area, some measure of the road obliterated (units 2, 3b, 4b, 18, 19, 22, 27, 31 and 60a), dependent upon activity use. Actual mileage of obliteration is dependent upon the amount of temporary road and legacy DSC overlap.

Further modeling of the proposed activities added the potential of lost EGC from wildfire and DSC for alternative 1. The same model inputs were used in WEPP the Wildfire Scenario used in Alternative 3, with the assumption that the proposed action would reduce the fire risk, so a Low Severity Fire was modeled (85% cover). In the modeling we see sediment prone acres that may offer input to streams; similar to those created by the proposed activities (Table 4). This modeling indicates; after the project is implemented, the assumed effects of wildfire would not be as intense and thus produce unmeasurable effects from the proposal and its required mitigations.

Provided all mitigating factors are present when proposed activity occurs, the anticipated DSC for a given unit or the proposal (as a whole) does not exceed 20% DSC criteria (LRMP).

Cumulative Effects

Spatial and Temporal Context for Effects Analysis

Cumulative effects are not expected from Resource Indicator and Measure (RIM) 1 – Mass movement, (Table 4).

Cumulative effects from RIM 2 – Erosion, are expected to be localized; unless influenced by a combination of wildfire and the erosion processes exposed to high winds. Winds can transport detached soil aloft and to a new location. This would prove to be a loss to soil productivity within a proposed unit, if this occurs it is unknown if some portion of this material would end up as sediment. The potential duration of expected erosion risk would be for at least 3 years immediately following wildfire (Elliott et al 2001 and Robichaud 2000). The volumes of erosion under this risk are also influenced by the intensity and duration of precipitation events that occur during elevated erosion risk.

Cumulative effects from RIM 3 – Sediment, are expected to be small with no elevation above assumed background levels (Harris, et.al. 2007) with the described mitigations and BMPs; unless like above influenced by wildfire. If wildfire takes place elevated. The potential duration of expected sediment risk would be for at least 3 years immediately following wildfire (Elliott et al 2001 and Robichaud 2000), assuming for a low severity wildfire and the reduced fuel loads.

Cumulative effects from RIM 4 – Detrimental Soil Conditions (DSC) that assumed to be created by equipment traffic seem to be long-lived (>40 years), with an exception in Kahler Unit 14. Soil development within Kalher has been mapped as having some measure of vertic soil properties; this feature was recognized in unit 14. Vertic soil properties seem to have erased the presence of equipment traffic. This was found by following the GPS location of mapped DSC, out of the area of vertic soils; where the rest of the DSC remained on the landscape. Thus it is assumed that the vertic properties (soil heave) overtime erased the legacy trail from the landscape (within the last 40 years). While this does show a restorative benefit to soils with vertic properties, it is not advisable to locate trails on these features. These soils also store a great deal of moisture from the clays that form these soils and locating equipment traffic through this soil may prove to have inputs to sediment sources; if these clays are suspended in puddles that sediment may have the opportunity to be routed to streams under high precipitation. Therefore units with soils described with vertic properties (units 7, 11b, 22, 23, 23a, and 28) should be evaluated during placement of any equipment traffic ways (Kahler design criteria).

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

All ground disturbing activities included in the list of past, present and reasonably foreseeable activities for the Kahler project in the EA (Chapter 3) are relevant to cumulative effects analysis for DSC.

Alternative 3 – Preferred Alternative

Project Design Features and Mitigation Measures

Per Multi-Use Sustainable Yield Act, FSM and LRMP the following design features and mitigations will be placed on Alternative 3.

1. Use of harvest equipment will not be permitted when soils reach field capacity for moisture, to limit the potential of long-term detrimental soil disturbance (Amaranthus et al. 1996, Bulmer et al. 2010, Froehlich et al. 1983, Heninger et al, 2002, Miller et al. 2004 and Page-Dumroese et al 2009.)

2. Placement of new temporary roads will be on deep soils, if it is operationally feasible. This will allow for adequate restoration of temporary roads and over time will leave less measurable detrimental soil condition across the proposed activity units (Archuleta, 2006, 2007, 2008). Lithosol (scab flats) and meadows will not be used for landings and skid trails; unless no other location is practical. If use is necessary disturbance will be kept to a minimum amount of the area, preferably at the edges of these features.

3. Within commercial harvest units, no harvest or heavy equipment will leave designated roads or trails, to limit the potential of detrimental soil disturbance. In the non-commercial thinning units, mechanical thinning equipment may be used provided that equipment that exceeds 7 PSI is not allowed to travel over the same path more than once. Some noncommercial thinning will be by sawyers (hand only).

A full list of BMPs, some with criteria driven by soil resource concerns have been incorporated within the EIS.

Direct and Indirect Effects

Table 5: Resource Indicators and Measures (RIM) for Alternative 3

Resource Element	Resource Indicator	Measure	Existing DSC Effects mi (ac) (Alt. 3)	Wildfire Influenced Effects on Existing DSC mi (ac) (Alt. 3)
1. Soil Stability	Soil Mass Wasting	No active areas identified	0.0	0.0
2. Soil Productivity	Erosion	Activity unit acres modeled >0.03t/ac	0.0	0/0
3. Water quantity	Sediment	Activity units that may produce >0.03t/ac	0.0	0/0
4. Detrimental Soil Conditions (DSC)	Change or absence in vegetation growth	Legacy trails in project area[7]	146 (39)	146 (39)
		Legacy trails in proposed Harvest Units[4]	6 (14)	6 (14)
		Legacy trails in current RHCA (class 2, 3, or 4 streams)[4]	6 (9)	6 (9)
		Legacy trails in area influenced by wildfire (400ft from streams)[4]	0 (0)	0 (0)

[7] While the presence of some DSC is known to increase sediment, it is currently covered with adequate EGC to limit sediment above background levels.

Resource Indicator and Measure 1

Soil mass movement was not identified in the area or as a risk that should play a role in any of the proposed activity units, therefore, it is assumed that mass movement will not influence the alternative 3 in the recent past, nor will it play a role in this alternative or the foreseeable future.

Resource Indicator and Measure 2

Similar to the previous alternative; this alternative 3 will have some effect on Soil Productivity (Erosion): harvest (Ground Based, Skyline, Helicopter and Prescribed Burning). Each of these methods has an expected impact to the DSC (Reeves, 2011, Archuleta, 1997 & 1999, Siskiyou NF, 1997 and Bennett, 1982), which can influence erosion.

As mentioned in the existing condition discussion, there are existing DSC within activity areas from past activity. Some of the proposed activity impacts (Alt 3) will overlap with proposed temporary roads. During the implementation of activates, there will be some elevation of risk to erosion. However BMPs (erosion control) will mitigate or diminish; if not all most of the short term effects from erosion. To estimate this risk the WEPP model was used.

While the WEPP modeling did not take on the ground slope profiles to input into the model, a range of slope characteristics were identified in GIS that cover the range of slope conditions found within the proposed units. WEPP uses two elements in the model. The upper element represents the disturbance activity (i.e. harvest), and a low element which represents the sediment buffer to a waterway. In the model the steepest slopes found in the units were used to represent the worst case scenario for erosion modeling (upper element 60%, lower element 40% to 60%). To display differences in effect to the RHCA treatments, a variety of buffer widths were used in the model (Table 12).

Results of the model runs for harvest and burning treatments showed that average annual erosion was the same as Alternative 2. The harvest example was using no disturbance other than removal of EGC. This is not to say under the extreme conditions (high precipitation, poor EGC left in place, or unplanned equipment traffic), erosion could not occur above background levels.

Based on the model runs and assumed background levels, it was determined that the harvest and prescribed burning would produce less sediment delivery than a high severity wildfire of similar size, so the Kahler harvest and burning in RHCA would be justified and no soils specific Design Criteria is recommended based on canopy removal.

When the WEPP model used the criteria to examine skid trails there was elevated erosion, so design criteria was developed. This information was used to limit the length of trails (225ft and 600ft); acceptable skidding lengths are based on slope breaks and are defined in the Design Criteria of this EIS.

The previously mentioned trails that will be used in the proposed activity as temporary roads will be subject to restoration (obliteration) of the DSC. As long as the proposed activity is allowed to use legacy trails, they can be eliminated by contract provision of a timber sales.

Resource Indicator and Measure 3

In Alternative 3 there will be some effect to the Resource element of Water Quality (Sediment). Mentioned in the existing condition discussion there is existing DSC from past activities. Each of these methods has an expected impact to the DSC (Reeves, 2011, Archuleta, 1997 & 1999, Siskiyou NF, 1997 and Bennett, 1982), which can influence sediment. Some of the proposed activity impacts will overlap with proposed temporary roads. During the implementation of activates, there will be some elevation of risk to erosion. However BMPs (sediment) will mitigate or diminish; most if not all, short term effects from erosion. To estimate this sediment risk the WEPP model was used the two soil textures of loam and silt loam are the only soil textures that were mapped within the proposed units.

Results of the model runs for harvest and burning treatments showed that average annual sediment was below background, <0.03t/ac (Harris, et.al. 2007). This means that harvest of trees (in or out of the RHCA), to the prescribed canopy density (>40% cover); would not show a measureable effect from sediment. This is not to say all proposed activities (in or out of the RHCA) would not have an effect to sediment (Table 12). Since skid trails are often extremely deficient of EGC, additional modeling was done to examine skid trails. Skid trails (a yarding method) are the one example when sediment could rise above background levels. A cover of 10% (skid trails) was used in WEPP model runs (Table 12). When skidding of trees was examined in relationship to the RHCA thinning, unlike the felling of trees; it was determined that a buffer was indeed needed to minimize the risk of sediment to streams. An additional mitigation from the WEPP analysis would be to retain at up to 30% EGC within the skid trail prism, especially with units that contain clay loam soils. This effect has a direct bearing in units 3b, 4, 4a, 44b, 5, 6, 7, 7a, 8, 11b, 12a, 13, 14, 15, 16, 17, 18b, 19, 21b, 23, 23b, 23c, 24, 25, 27a, 27b, 27c, 28a, 31, 31b, 35, 98 and 212. In these units it is recommended that skid trails adjacent to or draining toward RHCA will have 30% EGC.

Based on the model runs and assumed background levels, it was assumed that the harvest and prescribed burning would produce less sediment delivery than a high severity wildfire of similar size. The analysis thereby shows that the Kahler harvest and burning in RHCA would be justified and no Design Criteria is recommended based on canopy removal. Skid trails however may not be allowed to get closer than 75ft from a stream in RHCA treatments; in cases of increased slopes that buffer can be 100ft (Table 11). With all other streams the normal buffer distances will still apply, for both harvest and equipment traffic.

Some benefits to the sediment are expected from this alternative. As previously mentioned there are existing legacy trails. Some of these trails will be used as temporary roads in the project and subject to removal per the forest plan. Additionally since the temporary roads are used in the timber sale itself, it is allowable that under contract provisions of the timber sale they can be obliterated. These obliterated roads are considered restoration of the soil resource; in the event of a wildfire or similar defoliating event, the obliterated road will not offer a means of sediment inputs.

Resource Indicator and Measure 4

In Alternative 3 there will be some effect to Detrimental Soil Conditions (DSC). Mentioned in the existing condition discussion there is existing DSC from past activities. Each of these methods has an expected impact to the DSC (Reeves, 2011, Archuleta, 1997 & 1999, Siskiyou NF, 1997 and Bennett, 1982), which can influence sediment.

While Reeves offers a comprehensive list of expected detrimental effects, it appears these estimates may underestimate effects if certain conditions are present or absent. To offer an expected DSC that may be relevant to proposed activities and conditions present the following were used in DSC calculations; Ground Based 10% (Archuleta, 1997 & 1999), Skyline 5%, Helicopter (Siskiyou NF, 1997), Prescribed Burning (Bennett, 1982). Additionally, there may be some use of ground based equipment to pre-bunch helicopter loads to improve efficiency of helicopter logging. This activity will be done with a single pass to limit DSC described by Han (2006); the soil moisture for this activity will also be limited to dry conditions as a further mitigation.

Understanding the benefiting opportunities from fuel loading (slash) with yarding method may be an important factor to consider in the analysis. If harvest in a unit occurs before or as it transitions from moist to dry soil conditions; equipment may need to ride on slash to minimize DSC.

To illustrate how important this may be to the Kahler project, Figure 3 is offered as an example. In this harvest on the Umpqua NF (Flat IRTC)[8]; shows how some ground based yarding equipment is designed to float on slash, benefiting the soil resource; minimizing the detrimental effects of compaction and displacement. Slash was available for both sections, but the yarding systems required the harvester to use slash to minimize soil disturbance and the skidder to push it out of the way. The actual trails marked within the harvester section do not represent all trails used. The map only represents those trails needing to be obliterated by the harvest contractor in that IRTC (stewardship) project. There were “ghost trails” which registered no DSC disturbance (between mapped trails) used in the harvester section. These unmapped trails used a slash mats (>1 foot) to float equipment; leaving no measureable detrimental effects in their wake. Another reason that trails were around 80 to 100ft apart; the trees being harvested from “ghost trails” were directional felled to the mapped trails from unmapped trails. This allowed for the “ghost trail” to be used once in a single direction, effectively making a single pass and limiting DSC effects (Han, 2006)

The comparison in Figure 3 is important for the Kahler analysis; it is assumed that the opportunity to mitigate equipment disturbance with slash may not be an option in many Kahler project units. Therefore if harvester logging is used during implementation; it must occur after the soil has transitioned from moist to dry soil conditions. If this design criterion is not followed, the resulting effect will likely be similar to the skidder disturbance seen in Figure 3.

The elements of DSC are currently present in proposed units and will change in some areas by proposed activities. This change will take place mostly in association with the overlap of legacy trails and new temporary roads. Where this overlap occurs it is expected that there will an overall decrease in DSC for that segment of legacy trail.

Within the proposed planning area there are human created trails that measure approximately152 miles of assumed trail. The highest densities of visible trails in the project area are within the Wheeler Point Salvage units. These trails have appeared to have inhibited vegetation growth and type of plants. To verify this change the Soil Disturbance Monitoring Protocol was adapted to evaluate the recognized changes (Page-Dumroese, 2009). While not many of these effects seem to have been reduced over time, there is one instance in Unit 14, where the soil restored itself; this example is explained in the cumulative analysis section of this alternative.

The inhibition on plant growth seems to be related to trees and brush (with Juniper and Lodge Pole Pine being less affected); grasses, herbs and forbs in general may also have been influenced, but no measureable change was identified in the soils report. Estimates of DSC (Table 4) are based on the 2013 Kahler field observations (Table 13); in those site visits; 98,200ft of trails were examined. Of the trail sites measured, 31% was considered to be in DSC, when using the criteria from Page-Dumroese, et al (2009). That impact was used to evaluate potential impacts in units. When trails mapped were clipped to existing unit boundaries, 31% of clipped trails were calculated as DSC. Using this method it was determined that 3% DSC was the greatest DSC finding in a given unit. Therefore the DSC analysis used 3% DSC estimates for estimating existing DSC in ground based units where DSC was not measured in quality or quantity.

Therefore within the harvest units there is a total of 45 miles (65acres) of trail for a total of DSC (including system roads). Since only 31% of the evaluated impacts were deemed to be DSC; like alternative 1, we can assume 31% of the total DSC is a loss to the soil resource (13 miles or 20 acres). Of the legacy trails mapped in the project area, some measure of the road obliterated (units 3b, 4b, 18, 19, 22, 27, 31 and 60a), dependent upon activity use. Actual mileage of obliteration is dependent upon the

[8] Impacts were GPS located and later subsoiled to restore acceptable soil productivity to the entire unit

amount of temporary road and legacy DSC overlap. In this alternative unit 2 will not have any legacy trail rehabilitation.

Further modeling of the proposed activities added the potential of lost EGC from wildfire and DSC for alternative 1. The same model inputs were used in WEPP the Wildfire Scenario used in Alternative 2, with the assumption that the proposed action would reduce the fire risk, so a Low Severity Fire was modeled (85% cover). In the modeling we see sediment input to streams similar to those created by the proposed activities (Table 4). This modeling indicates; after the project is implemented, the assumed effects of wildfire would not be as intense and thus produce unmeasurable effects from the proposal and its required mitigations.

Provided all mitigating factors are present when proposed activity occurs, the anticipated DSC for a given unit or the proposal (as a whole) does not exceed 20% DSC criteria (LRMP).

Cumulative Effects

Spatial and Temporal Context for Effects Analysis

Cumulative effects are not expected from Resource Indicator and Measure (RIM) 1 – Mass movement, (Table 4).

Cumulative effects from RIM 2 – Erosion, are expected to be localized; unless influenced by a combination of wildfire and the erosion processes exposed to high winds. Winds can transport detached soil aloft and to a new location. This would prove to be a loss to soil productivity within a proposed unit, if this occurs it is unknown if some portion of this material would end up as sediment. The potential duration of expected erosion risk would be for at least 3 years immediately following wildfire (Elliott et al 2001 and Robichaud 2000). The volumes of erosion under this risk are also influenced by the intensity and duration of precipitation events that occur during elevated erosion risk.

Cumulative effects from RIM 3 – Sediment, are expected to be small with no elevation above assumed background levels (Harris, et.al. 2007) with the described mitigations and BMPs; unless like above influenced by wildfire. If wildfire takes place elevated. The potential duration of expected sediment risk would be for at least 3 years immediately following wildfire (Elliott et al 2001 and Robichaud 2000), assuming for a low severity wildfire and the reduced fuel loads.

Cumulative effects from RIM 4 – Detrimental Soil Conditions (DSC) that assumed to be created by equipment traffic seem to be long-lived (>40 years), with an exception in Kahler Unit 14. Soil development within Kalher has been mapped as having some measure of vertic soil properties; this feature was recognized in unit 14. Vertic soil properties seem to have erased the presence of equipment traffic. This was found by following the GPS location of mapped DSC, out of the area of vertic soils; where the rest of the DSC remained on the landscape. Thus it is assumed that the vertic properties (soil heave) overtime erased the legacy trail from the landscape (within the last 40 years). While this does show a restorative benefit to soils with vertic properties, it is not advisable to locate trails on these features. These soils also store a great deal of moisture from the clays that form these soils and locating equipment traffic through this soil may prove to have inputs to sediment sources; if these clays are suspended in puddles that sediment may have the opportunity to be routed to streams under high precipitation. Therefore units with soils described with vertic properties (units 7, 11b, 22, 23, 23a, and 28) should be evaluated during placement of any equipment traffic ways (Kahler design criteria).

Alternative 4

Project Design Features and Mitigation Measures

Per Multi-Use Sustainable Yield Act, FSM and LRMP the following design features and mitigations will be placed on Alternative 4.

1. Use of harvest equipment will not be permitted when soils reach field capacity for moisture, to limit the potential of long-term detrimental soil disturbance (Amaranthus et al. 1996, Bulmer et al. 2010, Froehlich et al. 1983, Heninger et al, 2002, Miller et al. 2004 and Page-Dumroese et al 2009.)

2. Placement of new temporary roads will be on deep soils, if it is operationally feasible. This will allow for adequate restoration of temporary roads and over time will leave less measurable detrimental soil condition across the proposed activity units (Archuleta, 2006, 2007, 2008). Lithosol (scab flats) and meadows will not be used for landings and skid trails; unless no other location is practical. If use is necessary disturbance will be kept to a minimum amount of the area, preferably at the edges of these features.

3. Within commercial harvest units, no harvest or heavy equipment will leave designated roads or trails, to limit the potential of detrimental soil disturbance. In the non-commercial thinning units, mechanical thinning equipment may be used provided that equipment that exceeds 7 PSI is not allowed to travel over the same path more than once. Some noncommercial thinning will be by sawyers (hand only).

A full list of BMPs, some with criteria driven by soil resource concerns have been incorporated within the EIS.

Direct and Indirect Effects

Table 6: Resource Indicators and Measures (RIM) for Alternative 4

Resource Element	Resource Indicator	Measure	Existing DSC Effects mi (ac) (Alt. 3)	Wildfire Influenced Effects on Existing DSC mi (ac) (Alt. 3)
1. Soil Stability	Soil Mass Wasting	No active areas identified	0.0	0.0
2. Soil Productivity	Erosion	Activity unit acres modeled >0.03t/ac	0.0	0/0
3. Water quantity	Sediment	Activity units that may produce >0.03t/ac	0.0	0/0
4. Detrimental Soil Conditions (DSC)	Change or absence in vegetation growth	Legacy trails in project area[9]	146 (39)	146 (39)
		Legacy trails in proposed Harvest Units[4]	12 (18)	12 (18)
		Legacy trails in current RHCA (class 2, 3, or 4 streams)[4]	6 (9)	6 (9)
		Legacy trails in area influenced by wildfire (400ft from streams)[4]	0 (0)	0 (0)

[9] While the presence of some DSC is known to increase sediment, it is currently covered with adequate EGC to limit sediment above background levels.

Resource Indicator and Measure 1

Soil mass movement was not identified in the area or as a risk that should play a role in any of the proposed activity units, therefore, it is assumed that mass movement will not influence the alternative 4 in the recent past, nor will it play a role in this alternative or the foreseeable future.

Resource Indicator and Measure 2

Similar to the previous alternatives the proposed activities of this alternative will have some effect on Soil Productivity (Erosion): harvest (Ground Based, Skyline, Helicopter and Prescribed Burning). Each of these methods has an expected impact to the DSC (Reeves, 2011, Archuleta, 1997 & 1999, Siskiyou NF, 1997 and Bennett, 1982), which can influence erosion.

As mentioned in the existing condition discussion, there are existing DSC within activity areas from past activity. Some of the proposed activity impacts (Alt 4) will overlap with proposed temporary roads. During the implementation of activates, there will be some elevation of risk to erosion. However BMPs (erosion control) will mitigate or diminish in most cases.

In this alternative the use of temporary roads is eliminated for units in Table 7. This change in temporary roads prompted a change in harvest method.

Table 7 Alt 4 units losing temporary road access.

Unit	Activity Method Alt 3	Activity Method Alt 4	Long Skidding Distance (Approx.)
28	Skyline/Helicopter	Helicopter	NA
29	Ground Based	Ground Based	1700ft (0.5ac)
32	Skyline/Helicopter	Helicopter	NA
40a	Ground Based	Ground Based	800ft (0.2ac)
43	Ground Based	Ground Based	NA[10]
49	Skyline/Helicopter	Helicopter	NA
58	Ground Based	Ground Based	1000ft (0.3ac)
73	Ground Based	Ground Based	5250ft (1.4ac) or 2660ft (0.7ac)[11]
201	Ground Based	Ground Based	1365ft (0.4ac)[12]
212	Ground Based	Non-Commercial Thinning	NA

As seen in Table 7, units 28, 32, 43, 49 and 212 should not see additional effects from the loss of temporary roads, because these units also changed logging method to a less impactful to the soil resource. While unit 43 did not move to a less impactful harvest method; it should not see much of a measureable difference without a temporary road. Though the unit remained a ground based harvest, the material being extracted and planned skidding should not have an increase in DSC in the unit[10]. The remaining units in table 6 start and remain as ground based harvest for alternative 4. These units are expected to retain traffic patterns that will use "long skid trails". It is assumed these effects will mirror the prism of temporary roads in Alternatives 2 and 3. These impacts are not named temporary roads, but will likely have the detrimental impact of a temporary road. The direct and indirect effects of repeated log transport within the prism of these trails will mimic the detrimental effects of temporary roads in Detrimental Soil Conditions (DSCs). As seen in Table 7, units 29, 40a, 58, 73 and 201 will see additional acres of DSC. While this

[10] Unit material is best described as NCT. Material will be skidded to Highway in center of unit.
[11] Material may travel along temporary road prism proposed in Alt 2&3 (2660ft) or out of unit 91 (5250ft).
[12] Unit will serve as landing for material exiting unit 32.

additional DSC effect in this alternative may seem in conflict with the purpose of the alternative; it was assumed these units were needed to meet the intent of the purpose and need (landscape scale treatments); thus the units were retained without temporary roads.

When the WEPP model used the criteria to examine skid trails there was elevated erosion, so design criteria was developed. This information was used to limit the length of trails (225ft and 600ft); acceptable skidding lengths are based on slope breaks and are defined in the Design Criteria of this EIS.

The previously mentioned trails that will be used in the proposed activity as temporary roads some will be subject to restoration (obliteration) of the DSC. As long as the proposed activity is allowed to use legacy trails, they can be eliminated by contract provision of a timber sales. Obliteration of long skid trails will not be proposed in this alternative. However it is recommended that the locations of these trails be recorded and monitored to effects overtime.

Despite the elimination of RHCA activity within this alternative; conditions and activities that can promote erosion occur in this alternative; long skid trails. However the WEPP analysis predicts that effective mitigation for that erosion can be achieved through the use of EGC (Effective Ground Cover). Provided that trails left in a compacted state retain >30% EGC or do not have greater than ft without a water bar; they should not produce erosion above background levels. Use of EGC will only be a short term solution, since it is very likely that units 29, 40a, 58, 73 and 201; will retain compacted conditions that represent long-term DSC. Thus erosion may become an issue later without continued EGC or obliteration of trail prisms.

Resource Indicator and Measure 3

In Alternative 4 there will be some effect to the Resource element of Water Quality (Sediment). Mentioned in the existing condition discussion there is existing DSC from past activities. Each of these methods has an expected impact to the DSC (Reeves, 2011, Archuleta, 1997 & 1999, Siskiyou NF, 1997 and Bennett, 1982), which can influence sediment. Some of the proposed activity impacts will overlap with proposed temporary roads. During the implementation of activates, there will be some elevation of risk to erosion. However BMPs (sediment) will mitigate or diminish; most if not all, short term effects from erosion. To estimate this sediment risk the WEPP model was used the two soil textures of loam and silt loam are the only soil textures that were mapped within the proposed units.

Results of the model runs for harvest and burning treatments showed that average annual sediment was below background, <0.03t/ac (Harris, et.al. 2007). This means that harvest of trees (in or out of the RHCA), to the prescribed canopy density (>40% cover); would not show a measureable effect from sediment. This is not to say all proposed activities (in or out of the RHCA) would not have an effect to sediment (Table 12). Since skid trails are often extremely deficient of EGC, additional modeling was done to examine skid trails. Skid trails (a yarding method) are the one example when sediment could rise above background levels. A cover of 10% (skid trails) was used in WEPP model runs (Table 12). When skidding of trees was examined in relationship to the RHCA buffers, unlike the felling of trees; it was determined that a no equipment buffer was indeed needed to minimize the risk of sediment to streams. An additional mitigation from the WEPP analysis would be to retain at up to 30% EGC within the skid trail prism, especially with units that contain clay loam soils. This effect has a direct bearing in units 3b, 4, 4a, 44b, 5, 6, 7, 7a, 8, 11b, 12a, 13, 14, 15, 16, 17, 18b, 19, 21b, 23, 23b, 23c, 24, 25, 27a, 27b, 27c, 28a, 31, 31b, 35, 98 and 212. In these units it is recommended that skid trails adjacent to or draining toward RHCA will have 30% EGC.

Based on the model runs and assumed background levels, it was assumed that the harvest and prescribed burning would produce less sediment delivery than a high severity wildfire of similar size. The analysis thereby shows that the Kahler harvest and burning in RHCA would be justified and no Design Criteria is recommended based on canopy removal. Skid trails however may not be allowed to get closer than 75ft from a stream in RHCA treatments; in cases of increased slopes that buffer can be 100ft (Table 11). With all other streams the normal buffer distances will still apply, for both harvest and equipment traffic.

Some benefits to the sediment are expected from this alternative. As previously mentioned there are existing legacy trails. Some of these trails will be used as temporary roads in the project and subject to removal per the forest plan, though to a lesser extent than alternatives 2 and 3. Additionally since the temporary roads are used in the timber sale itself, it is allowable that under contract provisions of the timber sale they can be obliterated. These obliterated roads are considered restoration of the soil resource; in the event of a wildfire or similar defoliating event, the obliterated road will not offer a means of sediment inputs.

Despite the elimination of RHCA activity within this alternative; conditions and activities that can promote erosion occur in this alternative; long skid trails. However the WEPP analysis predicts that effective mitigation for that erosion can be achieved through the use of EGC (Effective Ground Cover). Provided that trails left in a compacted state retain ≥30% EGC or do not have greater than ft without a water bar; they should not produce erosion above background levels. Use of EGC will only be a short term solution, since it is very likely that units 29, 40a, 58, 73 and 201; will retain compacted conditions that represent long-term DSC. Thus erosion may become an issue later without continued presence of ≥30% EGC or obliteration of trail prisms.

Resource Indicator and Measure 4

In Alternative 4 there will be some effect to Detrimental Soil Conditions (DSC). Mentioned in the existing condition discussion there is existing DSC from past activities. Each of these methods has an expected impact to the DSC (Reeves, 2011, Archuleta, 1997 & 1999, Siskiyou NF, 1997 and Bennett, 1982), which can influence sediment.

While Reeves offers a comprehensive list of expected detrimental effects, it appears these estimates may underestimate effects if certain conditions are present or absent. To offer an expected DSC that may be relevant to proposed activities and conditions present the following were used in DSC calculations; Ground Based 10% (Archuleta, 1997 & 1999), Skyline 5%, Helicopter (Siskiyou NF, 1997), Prescribed Burning (Bennett, 1982). Additionally, there may be some use of ground based equipment to pre-bunch helicopter loads to improve efficiency of helicopter logging. This activity will be done with a single pass to limit DSC described by Han (2006); the soil moisture for this activity will also be limited to dry conditions as a further mitigation.

Understanding the benefiting opportunities from fuel loading (slash) with yarding method may be an important factor to consider in the analysis. If harvest in a unit occurs before or as it transitions from moist to dry soil conditions; equipment may need to ride on slash to minimize DSC.

To illustrate how important this may be to the Kahler project, Figure 3 is offered as an example. In this harvest on the Umpqua NF (Flat IRTC)[13]; shows how some ground based yarding equipment is designed to float on slash, benefiting the soil resource; minimizing the detrimental effects of compaction and displacement. Slash was available for both sections, but the yarding systems required the harvester to use slash to minimize soil disturbance and the skidder to push it out of the way. The actual trails marked within the harvester section do not represent all trails used. The map only represents those trails needing to be obliterated by the harvest contractor in that IRTC (stewardship) project. There were “ghost trails”

[13] Impacts were GPS located and later subsoiled to restore acceptable soil productivity to the entire unit

which registered no DSC disturbance (between mapped trails) used in the harvester section. These unmapped trails used a slash mats (>1 foot) to float equipment; leaving no measureable detrimental effects in their wake. Another reason that trails were around 80 to 100ft apart; the trees being harvested from “ghost trails” were directional felled to the mapped trails from unmapped trails. This allowed for the “ghost trail” to be used once in a single direction, effectively making a single pass and limiting DSC effects (Han, 2006)

The comparison in Figure 3 is important for the Kahler analysis; it is assumed that the opportunity to mitigate equipment disturbance with slash may not be an option in many Kahler project units. Therefore if harvester logging is used during implementation; it must occur after the soil has transitioned from moist to dry soil conditions. If this design criterion is not followed, the resulting effect will likely be similar to the skidder disturbance seen in Figure 3. Within this alternative some units will see excessive use of long skid trails; used to replace temporary roads dropped from units 29, 40a, 58, 73 and 201. Once logging is concluded it is very likely that these long skid trails will reflect the effects of temporary roads from the volume of traffic and distance of skidding of harvested logs. These effects due to traffic volumes and intensity may create these conditions even in dry conditions with the loamy and silty textured soils.

The elements of DSC are currently present in proposed units and will change in some areas by proposed activities. This change will take place mostly in association with the overlap of legacy trails and new temporary roads. Where this overlap occurs it is expected that there will an overall decrease in DSC for that segment of legacy trail.

Within the proposed planning area there are human created trails that measure approximately152 miles of assumed trail. The highest densities of visible trails in the project area are within the Wheeler Point Salvage units. These trails have appeared to have inhibited vegetation growth and type of plants. To verify this change the Soil Disturbance Monitoring Protocol was adapted to evaluate the recognized changes (Page-Dumroese, 2009). While not many of these effects seem to have been reduced over time, there is one instance in Unit 14, where the soil restored itself; this example is explained in the cumulative analysis section of this alternative.

The inhibition on plant growth seems to be related to trees and brush (with Juniper and Lodge Pole Pine being less affected); grasses, herbs and forbs in general may also have been influenced, but no measureable change was identified in the soils report. Estimates of DSC (Table 4) are based on the 2013 Kahler field observations (Table 13); in those site visits; 98,200ft of trails were examined. Of the trail sites measured, 31% was considered to be in DSC, when using the criteria from Page-Dumroese, et al (2009). That impact was used to evaluate potential impacts in units. When trails mapped were clipped to existing unit boundaries, 31% of clipped trails were calculated as DSC. Using this method it was determined that 3% DSC was the greatest DSC finding in a given unit. Therefore the DSC analysis used 3% DSC estimates for estimating existing DSC in ground based units where DSC was not measured in quality or quantity.

Therefore within the harvest units there is a total of 45 miles (65acres) of trail for a total of DSC (including system roads). Since only 31% of the evaluated impacts were deemed to be DSC; like alternative 1, we can assume 31% of the total DSC is a loss to the soil resource (13 miles or 20 acres). Of the legacy trails mapped in the project area, some measure of the road obliterated (units 3b, 4b, 18, 19, 22, 27, 31 and 60a), dependent upon activity use. Actual mileage of obliteration is dependent upon the amount of temporary road and legacy DSC overlap. In this alternative some units 29, 40a, 58, 73 and 201 will see additional acres of DSC. By dropping the temporary road designations, the resulting trails will have the effects of temporary roads, but not the option of mitigation under the forest plan.

Further modeling of the proposed activities added the potential of lost EGC from wildfire and DSC for alternative 1. The same model inputs were used in WEPP the Wildfire Scenario used in Alternative 2, with the assumption that the proposed action would reduce the fire risk, so a Low Severity Fire was modeled (85% cover). In the modeling we see sediment input to streams similar to those created by the proposed activities (Table 4). This modeling indicates; after the project is implemented, the assumed effects of wildfire would not be as intense and thus produce unmeasurable effects from the proposal and its required mitigations.

Even with the additional acres of DSC from the effects of long skidding, with current and expected levels of DSC, this alternative does not exceed 20% DSC criteria (LRMP).

Cumulative Effects

Spatial and Temporal Context for Effects Analysis

Cumulative effects are not expected from Resource Indicator and Measure (RIM) 1 – Mass movement, (Table 4).

Cumulative effects from RIM 2 – Erosion, are expected to be localized; unless influenced by a combination of wildfire and the erosion processes exposed to high winds. Winds can transport detached soil aloft and to a new location. This would prove to be a loss to soil productivity within a proposed unit, if this occurs it is unknown if some portion of this material would end up as sediment. The potential duration of expected erosion risk would be for at least 3 years immediately following wildfire (Elliott et al 2001 and Robichaud 2000). The volumes of erosion under this risk are also influenced by the intensity and duration of precipitation events that occur during elevated erosion risk.

Cumulative effects from RIM 3 – Sediment, are expected to be small with no elevation above assumed background levels (Harris, et.al. 2007) with the described mitigations and BMPs; unless like above influenced by wildfire. If wildfire takes place elevated. The potential duration of expected sediment risk would be for at least 3 years immediately following wildfire (Elliott et al 2001 and Robichaud 2000), assuming for a low severity wildfire and the reduced fuel loads.

Cumulative effects from RIM 4 – Detrimental Soil Conditions (DSC) that assumed to be created by equipment traffic seem to be long-lived (>40 years), with an exception in Kahler Unit 14. Soil development within Kalher has been mapped as having some measure of vertic soil properties; this feature was recognized in unit 14. Vertic soil properties seem to have erased the presence of equipment traffic. This was found by following the GPS location of mapped DSC, out of the area of vertic soils; where the rest of the DSC remained on the landscape. Thus it is assumed that the vertic properties (soil heave) overtime erased the legacy trail from the landscape (within the last 40 years). While this does show a restorative benefit to soils with vertic properties, it is not advisable to locate trails on these features. These soils also store a great deal of moisture from the clays that form these soils and locating equipment traffic through this soil may prove to have inputs to sediment sources; if these clays are suspended in puddles that sediment may have the opportunity to be routed to streams under high precipitation. Therefore units with soils described with vertic properties (units 7, 11b, 22, 23, 23a, and 28) should be evaluated during placement of any equipment traffic ways (Kahler design criteria). Additionally, under this alternative DSC that may inhibit vegetative growth will increase in units that are ground based but do not have a temporary access (Temporary Road). This increase of DSC will limit plant growth or increase opportunities for weeds, but not exceed 20% DSC criteria (LRMP).

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

All ground disturbing activities included in the list of past, present and reasonably foreseeable activities for the Kahler project in the EA (Chapter 3) are relevant to cumulative effects analysis for DSC

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

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Regulatory Framework

Land and Resource Management Plan

The Umatilla National Forest Land and Resource Management Plan (LRMP) provides standards and guidelines for all activities.

The Desired Future Condition in the 1990 Forest Plan (LRMP) for water/soil is to maintain soil productivity (Forest Plan p. 4-9). The plan further states that Standards and Guidelines are to maintain a minimum of 80 percent of an activity area in a condition of acceptable productivity potential. Acceptable productivity is defined as:

- Less than 20% increase in bulk density of volcanic soil or a less than 15 percent increase in soil bulk density for other forest soils.
- Soil disturbance of less than 50 percent of the topsoil humus enriched A1 and or AC horizons from an area 100 sq. ft. (i.e. 5ft by 20ft)
    - Molding of the soil in vehicle tracks that area rutted to a depth less than 6 inches.
- Severely burned soil with the top layer of mineral soil altered in color (usually to red) and the next ½ inch blackened from organic matter charring.
- Plan and conduct land management activities so that soil loss from surface erosion and mass wasting, caused by activities will not result in an unacceptable reduction in soil productivity or water quality.
- Management activities shall be designed and implemented to retain sufficient ground vegetation and organic matter to maintain long-term soil and site productivity.
- Active slump and landslide area are considered unavailable for road construction. Areas with known landslide potential and lake sediments require special transportation planning and design, layout preconstruction, construction and maintenance techniques.

Federal Law

Multi-Use Sustainable Yield Act (1960)

The project with described mitigation and BMPs in place should be able to meet the intent and direction of the Sustained Yield Act. Sustained yield means achieving and maintaining into perpetuity a high-level annual or regular periodic output of renewable resources without impairment of the productivity of the land.

Clean Water Act

Minimizing the risk of sediment within the project and its design criteria was considered to help the Kahler Project meet the Clean Water Act.

Compliance with LRMP and Other Relevant Laws, Regulations, Policies and Plans

For the proposed actions within this proposed project there are no activities expected to exceed DSC defined by the forest plan. The highest expected DSC will be in unit the ground based unit 21 (17% or 8.7 acres DSC). The lowest DSC will be 11% in a variety of units.

The project with described mitigation and BMPs in place should be able to meet the intent and direction of the LRMP as it pertains to the soil resource.

It is assumed that the project being able to meet LRMP and FSM will lead to a project that will be considered sustainable in the terms of the Sustained Yield Act.

Short-term Uses and Long-term Productivity

Related to temporary roads in general, provided they are placed on a soil depth were restoration is possible, temporary roads can truly be temporary on the landscape. Often it is assumed that these activities will never return to a previous impact condition. When the literature is examined in this respect we see that numerous authors find this not to be the case (Archuleta, 2007 and 2008, Heninger et al 2002, Luce 1997). Taking this information into account we can assume that the installation (or reconstruction), use then obliteration of temporary roads will be short lived and that the effects will not harm the long-term productivity of the soil resource.

Unavoidable Adverse Effects

Irreversible and Irretrievable Commitments of Resources

As it may apply to temporary roads placed on shallow soils, these effects may be irreversible depending upon the depth of impact, organic matter present in the soil and the depth of the soil itself. While these areas are of minimal importance to timber production, but have a multitude of other resource values. These impacts over time may be colonized by noxious weeds and other pioneer species suited to such undeveloped conditions; which may lead to other resource damage. Therefore these types of impacts are expected to minimize to reduce the occurrence of irreversible damage to the soil resource.

Summary

When we consider the presence of Mollisols (grass developed soils) within the proposed units, this suggests that the development of these stands were started under a grassed condition. This information should be important to all alternatives when considering the past conditions and the potentially droughty nature of the soils within these stands. Taking these factors into account it is not expected that the proposed activities will harm or alter the further development of these soils.

Soil stability will not be changed by this project in any alternative.

The no action alternative will leave more DSC on the landscape that any of the action alternatives. This assumption is based on the expectation of obliteration of temporary roads and landings. These impacts if uncovered by a wildfire like the Wheeler Point Fire, may serve as a conduit for erosion and sediment over a short period (≤3years) to longer durations (14 years), depending upon the intensity of the wildfire (Robichaud, 2000).

Summary of Environmental Effects

The anticipated change in the soil resource will be minimal given the amount of restoration opportunities being left on the landscape in the form of legacy DSC (trails). Table 1, shows the change in DSC will range from the current estimate of 1582 to 1499 under alternative 3.

Table 8 Summary of Environmental Effects for the Kahler Project

Resource Element	Indicator/Measure	Alt 1	Alt 2	Alt 3	Alt 4
Soil Stability	Soil Mass Wasting	No effect.	No effect	No effect	No effect
Soil Productivity	Erosion	Given the current EGC the expectation of erosion elevated above background. However if the loss of EGC were to occur existing DSC 400ft from streams may produce some erosion. It is conceivable that these DSC features could route erosion to streams.	Given the proposed EGC in this alternative there is no expectation of erosion elevated above background. This is also true with the occurrence of a wildfire after treatment	Given the proposed EGC in this alternative there is no expectation of erosion elevated above background. This is also true with the occurrence of a wildfire after treatment	Given the proposed EGC in this alternative there is no expectation of erosion elevated above background. However there will be acres where DSC will limit the soils ability to produce EGC. This is also true with the occurrence of a wildfire after treatment
Water Quality	Sediment	Given the current EGC there is no expectation of sediment above background. However if the loss of EGC were to occur; existing DSC within 400ft of streams could offer a conduit sediment to streams above background levels	Given the proposed EGC in this alternative there is no expectation of sediment above background. This is true provided the buffer distances within RHCA are followed.	Given the proposed EGC in this alternative there is no expectation of sediment above background. This is true provided the buffer distances within RHCA are followed.	Given the proposed EGC in this alternative there is no expectation of sediment above background. This is true provided the buffer distances within RHCA are followed.
Existing DSC	Change in vegetation growth	With this alternative there is no opportunity to obliterate existing DSC. These areas will continue to have diminished soil both in and out RHCA.	With this alternative there is opportunity to obliterate existing DSC. This alternative will increase soil productivity both in and out RHCA.	With this alternative there is reduced opportunity to obliterate existing DSC. These areas will continue to be diminished both in and out RHCA.	With this alternative there is the least opportunity to obliterate existing DSC (Temporary Roads). Additionally, it will limit the opportunity to obliterate some created DSC that will mimic the effects of temporary roads. These areas will continue to be diminished both in and out RHCA.

Appendix

Acronyms

WEPP – Water Erosion Prediction Program, Forest Service model. Developed and tested by the Rocky Mountain Research Stations (RMRS).

TEUI – Terrestrial Ecosystem Unit Inventory, 3rd order soil survey with outputs compatible with NRCS county soil surveys.

Glossary

Pedoturbation – Mixing within a soil or sediment profile by various processes, such as animal burrowing, tree throw, freeze-thaw cycles, etc. It usually involves disturbance of the skeletal fabric as opposed to redistribution of only fine particles.

Chroma (Soil Color)

The relative purity, strength, or saturation of a color; directly related to the dominance of the determining wavelength of the light and inversely related to grayness; one of the three variables of color. See also Munsell color system, hue, and value.

Long skidding

Areas of concentrated equipment traffic; which have the effects of a temporary road.

Soil Orders

Andisol – development influenced by volcanic ejecta

Entisol – Recent development

Alfisol – Mildly acid clays formed under forested environment

Mollisol – Soft and dark from organic materials, typically formed under grasslands

Soil-disturbance Classes

Soil Disturbance Class 0 – Undisturbed

No evidence of past equipment. No depressions or wheel tracks. Forest-floor layers are present and intact. No soil displacement evident. No management-generated soil erosion. No management-created soil compaction. No management-created platy soils.

Soil-Disturbance Class 1

Wheel tracks or depressions are evident, but faint and shallow. Forest-floor layers are present and intact. Surface soil has not been displaced. Soil burn severity from prescribed fires is low (slight charring of vegetation, discontinuous). Soil compaction is shallow (0 to 4 inches). Soil structure is changed from undisturbed conditions to platy or massive albeit discontinuous.

Soil Disturbance Class 2

Wheel tracks or depressions are evident and moderately deep. Forest-floor layers are partially missing. Surface soil partially intact and maybe mixed with subsoil. Soil burn severity from prescribed fires is moderate (black ash evident and water repellency may be increased compared to pre-burn condition). Soil compaction is moderately deep (up to 12 inches). Soil structure is changed from undisturbed conditions and may be platy or massive.

Soil Disturbance Class 3

Wheel tracks or depressions are evident and deep. Forest-floor layers are missing. Surface soil is removed through gouging or piling. Surface soil is displaced. Soil burn severity from prescribed fires is high (white or reddish ash, all litter completely consumed, and soil structureless). Soil compaction is persistent and deep (greater than 12 inches). Soil structure is changed from undisturbed and is platy or massive throughout.

Soil Resource Inventories (SRIs)

Soil Survey Geographic Database (SSURGO)

Temporary Road

(FSM 7700) - A road necessary for emergency operations or authorized by contract, permit, lease, or other written authorization that is not a forest road and that is not included in a forest transportation atlas.

(LRMP) – Short term (temporary) roads will be obliterated.

Comment: For timber sale purposes, a temporary road is any haul route between a loading site and a forest road. An existing unauthorized road (see below) may only be used as a haul route once it has been authorized (new specified road construction or temporary road construction).

WEPP Inputs

Soil Texture, generated from TEUI

Cover (Treatment/Vegetation Buffer) for both Upper and Lower

Mature Forest = 100% (used for undisturbed forest)

Poor Grass = 40% (used for harvest removal)

Skid Trail = 10% *(used for equipment effects0

High Severity Wildfire = 45% (used for fire consumption in Alt 1)

Low Severity Wildfire = 85% (used for fire consumption in Alts 2 & 3

Gradient % (slopes) Range based on unit information

Horizontal Length (ft.) 700ft used to mimic; 6ooft skid trails and 100ft Class 4 RHCA buffer, 300ft used to mimic 200ft skid trails and 100ft class 4 RHCA buffer.

Rock (%)

Soil Descriptions Mapped within Project Area

Within the project area there are 38 individual soil series identified. Each is series is then mapped with a soil consociations, associations or a complex. The consociation is a single series, while the complex is composed of two or more soils series, or soils and a miscellaneous area (Rock Outcrop), plus allowable inclusions in either case. In the case of the complexes, each has a dominant soil; which is the first series used within the complex name. Within the project area there is one consociation (Bocker Series), the remaining 68 complex map units within the area are comprised of various series (listed below) or soil series complexes include rock outcrops.

ALBEE SERIES

The Albee series consists of moderately deep, well drained soils that formed in loess and ash mixed with colluvium weathered mostly from basalt. Albee soils are on ridgetops and plateaus. Slopes are 1 to 15 percent. The mean annual precipitation is about 26 inches and the mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, frigid Vitrandic Haploxerolls

TYPICAL PEDON: Albee ashy silt loam, rangeland.

ANATONE SERIES

The Anatone series consists of shallow, well drained soils formed in loess and ash mixed with residuum and colluvium from basalt, andesite or welded tuff. Anatone soils are on mountain side slopes, plateaus and ridgetops. Slopes are 0 to 90 percent. The mean annual precipitation is about 23 inches and the mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Lithic Haploxerolls

TYPICAL PEDON: Anatone very cobbly silt loam, pasture.

ATERON SERIES

The Ateron series consists of shallow, well drained soils on hills and mountains. They formed in colluvium and residuum, derived from basalt, tuff, andesite and greenstone. Slopes are 2 to 90 percent. The mean annual precipitation is about 14 inches and the mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Clayey-skeletal, smectitic, frigid Lithic Argixerolls

TYPICAL PEDON: Ateron very stony loam, rangeland.

BENNETTCREEK SERIES

Bennettcreek series consists of moderately deep, well-drained soils on mountain backslopes, formed in mantle of mixed volcanic ash and colluvium over colluvium and residuum from basalt, andesitic basalt or andesitic tuffbreccia. Slopes are 0 to 60 percent. Mean annual precipitation is about 24 inches and mean annual temperature about 39 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, isotic, frigid Vitrandic Haploxeralfs

BOCKER SERIES

The Bocker series consists of very shallow, well drained soils formed in colluvium and residuum derived from basalt mixed with loess and a small amount of volcanic ash in the surface. Bocker soils are on plateaus, hills and mountains. Slopes are 0 to 90 percent. The mean annual precipitation is about 25 inches and means annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Lithic Haploxerolls

TYPICAL PEDON: Bocker very cobbly silt loam - rangeland

BOLOBIN SERIES

The Bolobin series consists of moderately deep well drained soils on plateaus and hillslopes. They formed in colluvium from basalt with a mantle of mixed volcanic ash and loess. Slopes are 0 to 30 percent. Mean annual precipitation is about 20 inches and mean annual temperature about 43 degrees F.

TAXONOMIC CLASS: Fine-loamy, isotic, frigid Vitrandic Argixerolls

TYPICAL PEDON: Bolobin ashy silt loam, forest - on a 20 percent south-facing slope at 4,120 feet elevation.

BOLONY SERIES

The Bolony series consists of moderately deep well drained soils on scarp slopes of dissected basalt plateaus. Bolony soils formed in colluvium from basalt with loess and a small amount of volcanic ash in surface horizons. Slopes are 15 to 60 percent. Mean annual precipitation is about 20 inches and mean annual temperature about 43 degrees F.

TAXONOMIC CLASS: Fine-loamy, isotic, frigid Vitrandic Argixerolls

TYPICAL PEDON: Bolony ashy silt loam - forest, on a 35 percent north-facing slope at 4,010 feet elevation.

CANEST SERIES

The Canest series consists of very shallow, well drained soils that formed in material weathered from igneous rocks. Canest soils are on basalt plateaus and have slopes of 1 to 20 percent. The mean annual precipitation is about 14 inches, and the mean annual temperature is about 44 degrees F.

TAXONOMIC CLASS: Clayey-skeletal, smectitic, frigid Aridic Lithic Argixerolls

TYPICAL PEDON: Canest very cobbly clay loam - rangeland, on a slope of 2 percent in sagebrush steppe at elevation of 5,008 feet.

CRACKERCREEK SERIES

The Crackercreek series consists of deep, well drained soils on north- facing mountainsides and canyon walls. These soils formed in a volcanic ash mantle over colluvium weathered from basalt. Slopes are 30 to 60 percent. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F. and the average frost-free season is 60 to 110 days.

TAXONOMIC CLASS: Ashy over loamy-skeletal, glassy over mixed, superactive, frigid Alfic Vitrixerands

TYPICAL PEDON: Typical pedon of Crackercreek stony silt loam, 30 to 60 percent slopes; woodland.

DUNSTAN SERIES

The Dunstan series consists of deep, well-drained soils on mountain backslopes. Dunstan soils formed in a mixed mantle of volcanic ash and loess overlying colluvium and residuum from andesitic tuff breccia or basalt. Slopes are 0 to 90 percent. Mean annual precipitation is about 28 inches and mean annual temperature about 40 degrees F.

TAXONOMIC CLASS: Clayey-skeletal, smectitic, frigid Vitrandic Haploxeralfs

TYPICAL PEDON: Dunstan ashy silt loam forested, on a 42 percent west facing slope at an elevation of 5,100 feet.

FIVEBEAVER SERIES

The Fivebeaver series consists of shallow, well-drained soils on plateaus and backslopes of mountains. Fivebeaver soils formed in colluvium from basalt or andesite mixed with a small amount of volcanic ash. Slopes are 0 to 90 percent. Mean annual precipitation is about 30 inches and mean annual temperature about 42 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, isotic, frigid Lithic Ultic Haploxerolls

TYPICAL PEDON: Fivebeaver gravelly ashy silt loam, forested, on an 8 percent northeast slope at 4,940 feet elevation.

FIVEBIT SERIES

The Fivebit series consists of shallow, well drained soils on ridgetops and side slopes of mountains. They formed in colluvium weathered from rhyolitic tuff, andesite, or basalt. Slopes are 0 to 90 percent. The mean annual precipitation is about 25 inches and the mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Loamy-skeletal mixed, superactive, frigid Lithic Ultic Haploxerolls.

TYPICAL PEDON: Fivebit extremely stony loam - on a 25 percent convex south-facing slope, rangeland.

GRUBCREEK SERIES

The Grubcreek series consists of moderately deep, well-drained soils on backslopes of mountains. Grubcreek soils formed in colluvium from andesite, andesitic basalt or basalt with a minor amount of volcanic ash. Slopes are 0 to 90 percent. Mean annual precipitation is about 31 inches and mean annual temperature about 43 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, isotic, frigid Vitrandic Haploxerolls.

TYPICAL PEDON: Grubcreek gravelly ashy loam - forested, on a 12 percent southwest facing slope at an elevation of 6,160 feet.

GWIN SERIES

The Gwin series consists of shallow, well drained soils that formed in colluvium and residuum from basalt mixed with loess. Gwin soils are on basalt plateaus, ridges, foothills, and canyons. Slopes range from 0 to 90 percent. The mean annual precipitation is about 20 inches, and the mean annual temperature is about 48 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, mesic Lithic Argixerolls

TYPICAL PEDON: Gwin cobbly silt loam, rangeland

GWINLY SERIES

The Gwinly series consists of shallow, well drained soils that formed in loess and colluvium from basalt and tuff. Gwinly soils are on hills, mountains, and canyons. Slopes are 2 to 120 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 48 degrees F.

TAXONOMIC CLASS: Clayey-skeletal, smectitic, mesic Lithic Argixerolls

TYPICAL PEDON: Gwinly very cobbly silt loam, rangeland.

HAFMAU SERIES

The Hafmau series consists of shallow, moderately well drained soils on rolling mountain side slopes and benches. They formed in mixed volcanic ash and colluvium over residuum from basalt or tuffs. Slopes are 5 to 40 percent. The mean annual precipitation is about 22 inches and the mean annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Clayey-skeletal, smectitic, frigid Lithic Ultic Argixerolls

TYPICAL PEDON: Hafmau stony ashy sandy loam, upland forest.

HARLOW SERIES

The Harlow series consists of shallow, well drained soils formed in loess and colluvium from basalt or argillite. Harlow soils are on canyons, structural benches, and basalt plateaus. Slopes are 2 to 90 percent. The average annual precipitation is about 26 inches and average annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Clayey-skeletal, smectitic, frigid Lithic Argixerolls.

TYPICAL PEDON: Harlow very stony clay loam- rangeland on a 55 percent southwest facing slope at an elevation of 4,320 feet.

HUMAREL SERIES

The Humarel series consists of moderately deep, well-drained soils on backslopes of mountains. Humarel soils formed in colluvium and residuum, from welded pyroclastic flows or clay-producing mafic extrusive rocks, with a minor amount of volcanic ash in surface layers. Slopes are 0 to 90 percent. Mean annual precipitation is about 28 inches and mean annual temperature about 40 degrees F.

TAXONOMIC CLASS: Clayey-skeletal, smectitic, frigid Vitrandic Argixerolls

TYPICAL PEDON: Humarel very gravelly ashy clay loam - forested, on a 22 percent west facing slope at 4,200 feet elevation.

KAMELA SERIES

The Kamela series consists of moderately deep, well drained soils that formed in residuum and colluvium weathered from basalt, with an influence of loess and volcanic ash in the surface. Kamela soils are on mountains and have slopes of 0 to 90 percent. The mean annual precipitation is about 30 inches and the mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, isotic, frigid Vitrandic Haploxerepts

TYPICAL PEDON: Kamela stony ashy silt loam, timbered.

KLICKER SERIES

The Klicker series consists of moderately deep well drained soils formed in loess mixed with volcanic ash, and slope alluvium and colluvium from basalt. Klicker soils are on mountains, plateaus, and benches. Slopes are 0 to 90 percent. The average annual precipitation is about 30 inches and average annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, isotic, frigid Vitrandic Argixerolls

TYPICAL PEDON: Klicker stony ashy silt loam- forested

KLICKSON SERIES

The Klickson series consists of deep or very deep, well drained soils that formed in mixed loess and ash and colluvium and residuum weathered from basalt. Klickson soils are on north-facing side slopes of canyons, escarpments on hills, structural benches and the lower slopes of mountains. Permeability is moderate or moderately slow. Slope ranges from 7 to 90 percent. The average annual precipitation is about 26 inches and the average annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, isotic, frigid Vitrandic Argixerolls

TYPICAL PEDON: Klickson ashy silt loam - on a 61 percent northeast-facing slope at 3,200 feet elevation in forest.

LAMULITA SERIES

The Lamulita series consists of deep, well-drained soils on back slopes of mountains and foothills. Lamulita soils formed in colluvium and residuum, from andesitic tuff breccia mudflow deposits and other clay producing basic igneous rocks, with a minor amount of volcanic ash in surface layers. Slopes are 0 to 60 percent. Mean annual precipitation is about 28 inches and mean annual temperature about 40 degrees F.

TAXONOMIC CLASS: Clayey-skeletal, smectitic, frigid Vitrandic Argixerolls

TYPICAL PEDON: Lamulita ashy clay loam -- forest, on a 35 percent south facing slope at 4,640 feet elevation.

LARABEE SERIES

The Larabee series consists of well drained, moderately deep soils on hills and canyons. They formed in colluvium weathered from basalt or welded tuff with an influence of loess and volcanic ash. Permeability is moderately slow. Slope ranges from 0 to 90 percent. The average annual temperature is about 43 degrees F and the average annual precipitation is about 27 inches.

TAXONOMIC CLASS: Loamy-skeletal, isotic, frigid Vitrandic Argixerolls

TYPICAL PEDON: Larabee ashy loam -- on a 22 percent south-facing slope at 4,690 feet elevation in forest.

LIMBERJIM SERIES

The Limberjim series consists of deep, well drained soils on stable slopes of mountains, plateaus, canyons, and structural benches. Limberjim soils formed in ash over colluvium and residuum derived from basalt and andesitic breccias. Slopes are 0 to 90 percent. The mean annual precipitation is about 30 inches and the mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Ashy over loamy-skeletal, amorphic over isotic, frigid Alfic Udivitrands

TYPICAL PEDON: Limberjim ashy silt loam - Woodland, on a 5 percent planar southeast-facing slope at an elevation of 4,490 feet.

LOWERBLUFF SERIES

The Lowerbluff series consists of shallow, well drained soils on ridgetops of plateaus. Lowerbluff soils formed in mixed volcanic ash, loess, and colluvium derived from basalt and metavolcanics. Slopes are 0 to 15 percent. The mean annual precipitation is about 25 inches and the mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Ashy, mixed, frigid Lithic Vitrixerands

TYPICAL PEDON: Lowerbluff ashy silt loam - Woodland, on a 15 percent irregular northeast-facing slope at an elevation of 4,900 feet.

MALLORY SERIES

The Mallory series consists of moderately deep well drained soils formed in loess and slope alluvium, and colluvium from basalt. Mallory soils are on canyon walls, hills and shoulders and have slopes of 2 to 90 percent. The average annual precipitation is 17 to 25 inches and average annual temperature is about 48 degrees F.

TAXONOMIC CLASS: Clayey-skeletal, smectitic, mesic Pachic Argixerolls

TYPICAL PEDON: Mallory very stony silt loam- rangeland, on a 60 percent southwest slope at an elevation of 2,520 feet.

MEAUFUN SERIES

The Meaufun series consists of deep, well drained soils on backslopes of mountains. Meaufun soils formed in volcanic ash mixed with colluvium overlying clay-producing tuffs or olivine basalt. Slopes are 0 to 60 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Fine, smectitic, frigid Vertic Palexerolls

TYPICAL PEDON: Meaufun ashy loam - woodland, on a 28 percent southwest-facing slope at an elevation of 3,980 feet.

MELHORN SERIES

The Melhorn series consists of very deep well drained soils on plateaus and mountains. Melhorn soils are formed in volcanic ash and loess overlying colluvial material derived from basalt. Slopes are 0 to 60 percent. The mean annual precipitation is about 23 inches and the mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Fine-loamy, isotic, frigid Vitrandic Argixerolls

TYPICAL PEDON: Melhorn ashy silt loam, woodland, on a 34 percent northwest - facing slope at an elevation of 3,640 feet. (

NIBOLOB SERIES

The Nibolob series consists of deep, well drained soils on gently sloping plateau surfaces. Nibolob soils formed in a mantle of volcanic ash mixed with loess overlying basalt colluvium. Slopes are 0 to 30 percent. Mean annual precipitation is about 22 inches and mean annual temperature about 43 degrees F.

TAXONOMIC CLASS: Fine-loamy, isotic, frigid Vitrandic Argixerolls

TYPICAL PEDON: Nibolob ashy silt loam - forest, on an 18 percent south facing slope at 3,275 feet elevation.

OLOT SERIES

The Olot series consists of moderately deep, well drained soils that formed in volcanic ash and colluvium and residuum weathered from basalt. Olot soils are on plateaus and mountains and have slopes of 2 to 90 percent. The mean annual precipitation is about 27 inches and the mean annual temperature is about 44 degrees F.

TAXONOMIC CLASS: Ashy over loamy-skeletal, glassy over isotic, frigid Typic Vitrixerands

TYPICAL PEDON: Olot stony ashy silt loam, wooded.

PARSNIP SERIES

The Parsnip series consists of shallow, well drained soils that formed in mixed loess and volcanic ash over basalt. Parsnip soils are on structural benches and plateaus. Slopes are 0 to 30 percent. The mean annual precipitation is about 16 inches and the mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Loamy, mixed, superactive, frigid Lithic Argixerolls

TYPICAL PEDON: Parsnip ashy silt loam - rangeland, on a 2 percent slope at an elevation of 4700 feet.

RAYCREEK SERIES

The Raycreek series consists of moderately deep, well drained soils formed in metasedimentary colluvium and residuum with volcanic ash in the surface. These soils are found on gentle side slopes which border wet meadows. Slopes are 4 to 25 percent. The mean annual precipitation is about 19 inches, and the mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Fine-loamy, isotic, frigid Vitrandic Argixerolls

TYPICAL PEDON: Raycreek ashy loam - woodland, on a 15 percent, west-facing slope at an elevation of 5,100 feet

ROCKLY SERIES

The Rockly series consists of shallow and very shallow, well drained soils formed in residuum and colluvium from basalt with an influence of loess and minor amounts of volcanic ash. Rockly soils are on mesas, ridges, plateaus, structural benches, canyon walls, and south and west slopes on hills. Slopes are 0 to 120 percent. The mean annual precipitation is about 18 inches, and the mean annual temperature is about 48 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, mesic Lithic Haploxerolls

TYPICAL PEDON: Rockly very gravelly loam – rangeland

SHARPRIDGE SERIES

The Sharpridge series consists of deep and very deep, well drained soils formed in a mantle of volcanic ash over colluvium weathered from tuff on mountain foot slopes and backslopes. Slope gradients are 5 to 60 percent. Mean annual precipitation is about 24 inches and mean annual temperature about 41 degrees F.

TAXONOMIC CLASS: Ashy over clayey, amorphic over smectitic, frigid Alfic Vitrixerands

TYPICAL PEDON: Sharpridge ashy silt loam - woodland, on a 26 percent north-facing slope at an elevation of 4,280 feet.

SOPHER SERIES

The Sopher series consists of deep, well drained soils formed in reworked volcanic ash and loess over clayey colluvium. Sopher soils are on structural benches, plateaus, or canyons. Slopes are 15 to 90 percent. The mean annual precipitation is about 21 inches and the mean annual temperature is about 47 degrees F.

TAXONOMIC CLASS: Clayey-skeletal, smectitic, mesic Vitrandic Haploxeralfs

TYPICAL PEDON: Sopher stony ashy loam, woodland, on a 25 percent slope at an elevation of 2,800 feet.

SYRUPCREEK SERIES

The Syrupcreek series consists of moderately deep, well drained soils on ridgetops and side slopes of mountains and plateaus. Syrupcreek soils formed in ash and loess over colluvium and residuum derived from basalt and andesitic brecias. Slopes are 0 to 60 percent. The mean annual precipitation is about 35 inches and the mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Ashy over loamy-skeletal, amorphic over isotic, frigid Alfic Udivitrands

TYPICAL PEDON: Syrupcreek ashy silt loam - Woodland, on a 3 percent planar northeast-facing slope at an elevation of 4385 feet.

TOLO SERIES

The Tolo series consists of deep and very deep, well drained soils that formed in volcanic ash over mixed loess and colluvium from basalt. Tolo soils are on basalt plateaus and mountains and have slopes of 2 to 65 percent. The mean annual precipitation is about 30 inches, and the mean annual temperature is about 44 degrees F.

TAXONOMIC CLASS: Ashy over loamy, amorphic over isotic, frigid Alfic Vitrixerands

TYPICAL PEDON: Tolo ashy silt loam, forested, on a 10 percent northeast-facing slope at an elevation of 3,400 feet.

TOMMYCORK SERIES

The Tommycork series consists of moderately deep, well drained soils on backslopes of dissected basalt plateaus. Tommycork soils formed in colluvium from basalt with loess and a small amount of volcanic ash in surface horizons. Slopes are 0 to 60 percent. Mean annual precipitation is about 19 inches and mean annual temperature about 43 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, frigid Vitrandic Argixerolls

TYPICAL PEDON: Tommycork ashy silt loam - rangeland, on a 2 percent north facing slope at an elevation of 4,100 feet.

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Subsoiling Prescription:

TEMPORARY ROADS & OTHER SOIL COMPACTION ON VARIOUS SLOPES AND SOIL CONDITIONS - Kahler Dry Forest Restoration Project

PHYSICAL CONDITIONS

Proposed for use during harvest activities in the Kahler project are “existing” temporary roads and created temporary roads. Though the name “existing” temporary roads seems to be an error, it describes remnant legacy trails and roads; left to recover via natural processes (passive restoration). Unfortunately the anticipated recovery did not occur, leaving the legacy impacts on the landscape.

All estimates of area are the known distance of proposed roads and an assumed width of temporary road, (distance of road (ft.) * 12ft width = Acres) actual locations are identified in table 1. Actual width of these roads may vary + 3 feet along various segments of roads/trails from variation in traffic impacts. The variation in traffic impacts are from forest visitor use around fallen trees or other traffic obstructions. The following sections of this document segregate current and proposed road/trails to estimate the current impacts on the landscape. Any variation of treatment is to be based upon anticipated soil depth alone. All treatments will receive the addition of slash to amend the soil of both existing and proposed temporary roads/trails.

Table 9 Soil Depth as an indicator of restoration opportunity.

SOIL DEPTH: INDICATOR OF SUBSOILING OPPERTUNTIY					
		Soil 2			
		Shallow (<20")	Moderately Deep (20"-40")	Deep (40"-60")	Very Deep (>60")
Soil 1	Shallow (<20")	Scarify	Scarify	Scarify or Subsoil	Scarify or Subsoil
	Mod. Deep (20"-40")	Scarify or Subsoil	Scarify or Subsoil	Scarify or Subsoil	Scarify or Subsoil
	Deep (40"-60")	Scarify or Subsoil	Subsoil	Subsoil	Subsoil
	Very Deep (>60")	Subsoil	Subsoil	Subsoil	Subsoil

In **Error! Reference source not found.**, Soil 1 and soil 2 are first and second soil named in the mapped soil complex for the area in being examined. Soil depth is based on NRCS criteria.

Table 10 Proposed obliteration equipment for temporary roads.

SOIL ROCK CONTENT (0 to 15inches): INDICATOR OF EQUIPMENT SUITED TO OBLITERATE TEMPORARY ROADS					
		Soil 2 has:			
		60% to 45% rock	44% to 30% rock	29% to 5% rock	4% to <1% rock
Soil 1	60% to 45% rock	Excavator	Excavator	Excavator	Excavator or Dozer
	44% to 30% rock	Excavator	Excavator	Excavator	Excavator or Dozer
	29% to 5% rock	Excavator or Dozer	Excavator or Dozer	Excavator or Dozer	Excavator or Dozer
	4% to <1% rock	Excavator or Dozer	Excavator or Dozer	Excavator or Dozer	Excavator or Dozer

In Table 10, when obliteration is prescribed and which equipment that is most likely to achieve best overall results when considering temporary road spatial location; with rock content of mapped soils

EXISTING TEMPORARY ROAD CONDITIONS

The use of the term temporary road in this case is erroneous, since temporary implies these roads will not remain on the landscape. Due to various environmental factors passive restoration did not take place; therefore these obliteration treatments are deemed necessary to ensure the use of temporary roads will indeed be temporary. Locating these roads/trails has been possible by identifying berms and/or wheel ruts consistent with roads, either from field observations or from remote sensing (Aerial Photographs).

TREATMENT OF CREATED OR LEGACY SOIL COMPACTION

The presence of legacy compaction (existing temporary roads) within the proposed activity area is the reason for subsoiling all temporary roads utilized within the Kahler project proposal. Location of specific roads are mapped and identified in GIS in the Kahler project folder. In addition to removal of temporary roads, any temporary landing will also receive the same subsoiling treatment as its associated temporary road.

Ridge Top Roads

The soil conditions associated with these roads are typically a shallow in soil depth (some occurrence of moderately deep soil may be present).

1. If soil is to a depth >20 inches, subsoiling will be to a depth of at least 20 inches.
    a. If bedrock is <20 inches surface, scarification will be to the lithic (rock) contact or at least 10 inches.

2. Effective Ground Cover (EGC) for all subsoiling treatments is a requirement. Where available EGC will take advantage of harvest create slash. If no suitable organic material is available, then use of certified weed-free straw is appropriate.
    a. Stabilization of soil surface with Slash (or organic material) is done to prevent resulting subsoiling treatment from soil crusting conditions. Crusting can inhibit moisture infiltration and promote erosion (Luce 1997).

Mid-slope Roads

The soil conditions associated with these roads are typically a moderately deep to deep soil; depending upon associated geology and road fill depths.

1. If soil is to a depth >20 inches, subsoiling will be to a depth of at least 20 inches.
    a. If bedrock is <20 inches surface, scarification will be to the lithic (rock) contact or at least 10 inches.
2. If there is a need to restore hillside hydrology by re-contouring the road; subsoiling will be limited to the compacted roadbed not excavated during re-contouring.
3. Effective Ground Cover (EGC) for all subsoiling treatments is a requirement. Materials used for EGC will take advantage of available harvest slash. If no suitable organic material is available, then use of certified weed-free straw is appropriate.
    a. Stabilization of soil surface with Slash (or organic material) is done to prevent resulting subsoiling treatment from soil crusting conditions. Crusting can inhibit moisture infiltration and promote erosion (Luce 1997).

Toe Slope and/or Gentle Topography roads

The soil conditions associated with these roads can vary from deep soil in Toe slopes; to varying depth (shallow to very deep) in gentle topography.

1. If soil is to a depth >20 inches, subsoiling will be to a depth of at least 20 inches.
    a. If bedrock is <20 inches surface, scarification will be to the lithic (rock) contact or at least 10 inches.
2. Effective Ground Cover (EGC) for all subsoiling treatments is a requirement. Materials used for EGC will take advantage of available harvest slash. If no suitable organic material is available, then use of certified weed-free straw is appropriate.
    a. Stabilization of soil surface with Slash (or organic material) is done to prevent resulting subsoiling treatment from soil crusting conditions. Crusting can inhibit moisture infiltration and promote erosion (Luce 1997).

Equipment for Subsoiling Activities: Benefits and prescriptive limits for each

Dozer: Rear mounted winged subsoiling shanks are the only dozer mounted option to be considered If project does not have adequate EGC component, then dozer subsoiling may be considered best economic value to for work. However for the above prescription dozer equipment alone is not the best suited for easy completion of all aspects of the above subsoiling prescription.

Benefits

1. Subsoiling operation done with the greatest speed.
2. Some implements are built and well suited for use in areas with minimal trees.

Prescriptive Limits

1. Operator is not in constant visual contact with work activity.
    a. Can cause subsurface rock and boulders to be brought to the surface in some cases.
    b. Subsoiling with a dozer can lead to vegetation accumulations in equipment that will leave exposed soil from displaced vegetation.
    c. Fuels Specialist may consider displaced vegetation concentrations, a fuel hazard.
    d. Subsoiling can damage retained tree roots, since operator may not always be aware of implement actions as they concentrate on driving the dozer.
2. Dozer subsoiling forms linear patterns, sometimes leaving subsoiling furrows.
    a. Subsoiling furrows can offers the least desired amount of microsite conditions for seeds and seedling plants and create un-natural appearance of planted furrows; even if only seeds from soil seed bank sprout.
    b. If treatment lacks EGC and soil lacks Organic Matter (OM or harvest debris), this may lead to soil crusting that can cause the soil surface to seal; followed by accelerated erosion (Luce 1997).
3. All subsoiling activities will require use some form of EGC. When harvest debris is not available, straw (or other OM) will be required. Due to the operational limitations of the dozer, this may require hand crew application of EGC following subsoiling.

Excavator (approximately a Cat 200LC or Log Loader) without the aid of any specialized subsoiling attachments. Equipment is not the best suited for easy completion of all aspects of the above subsoiling prescription.

Benefits

1. Operator is in constant visual contact with work activity.
    a. Therefore, they are aware of subsurface obstructions and prevent damage to trees, equipment or bring large boulders and rocks to the surface.
2. Work can be done concurrently with machine piling project work, thus could be a cost effective means of accomplishing both machine piling and subsoiling compacted soils like temporary roads.
3. Subsoiling & Grapple Piling work is accomplished from a single work. (See Figure 2).

4. Excavator is able to take advantage of surrounding harvest slash for use as EGC. When OM (Harvest Slash) is not available, straw (or other OM) will be required. The excavator has the operational ability to apply EGC following subsoiling, without needing a hand crew.
5. Some operators have retrofitted their logging equipment to meet the needs of this prescription and have accomplished similar results to the specialized equipment mentioned in the next excavator example.

Prescriptive Limits

1. Excavator Subsoiling operations has the slowest completion rate when using a bucket alone to subsoil.
    a. Because, the excavator accomplishes subsoiling by entering the soil with the bucket as if to excavate, curling in the bucket to break compaction without rising from the ground. The buckets action is then reversed to exit the soil without mixing the soil profiles (i.e. horizons). Treatment area is little more than the area in contact with the bucket.
    b. The excavator may use an un-attached subsoiling implement to achieve defined work, by holding implement between excavator thumb and bucket.
        i. Improved rate of work, but still has problems with retaining implement in a proper position for subsoiling. Over time this can also damage subsoiling implements not constructed for use in this fashion.
2. When operating in grassed locations with widely spaced trees, the rate of accomplishment is low when compared to dozer work.

Excavator (i.e. ~ Cat 200LC): with a specialized subsoiling attachment. This equipment is best suited for easy completion of all aspects of the above subsoiling prescription.

Benefits

1. Specialized subsoiling attachments can be a Subsoiling Grapple Rake (Archuleta and Karr 2006) or a Subsoiling Excavator Bucket (Archuleta and Karr 2006), or other suitable implement.
    a. Operator is in constant visual contact with work activity.
        i. Therefore, they are aware of subsurface obstructions and prevent damage to equipment or surfacing of large boulders and rocks.
    b. Subsoiling operation with this implement has an improved rate of completion over other excavator subsoiling methods.
        i. This method is still slower than dozer subsoiling, but when considering the fast application of EGC; the total project time is faster than dozer work.
    c. The excavator accomplishes subsoiling by; rotating head into subsoiling mode (see Figure 1). Subsoiling occurs from a single stationary work position (see Figure 2), then excavator moves to new position and process.

d. EGC is placed when implement is placed into grapple rake mode for placement of EGC (see figure 2).

2. Work can be done concurrently with machine piling project work, thus could be a cost effective means of accomplishing both machine piling and subsoiling compacted soils like temporary roads.

3. Excavator is able to take advantage of surrounding harvest slash for use as EGC. When OM (Harvest Slash) is not available, straw (or other OM) will be required. The excavator has the operational ability to apply EGC following subsoiling, without needing a hand crew.

Prescriptive Limits

1. When operating in grassed locations with widely spaced trees, the rate of accomplishment is low when compared to dozer work, since tightly spaced stumps limits the speed of dozer subsoiling.

Analysis Data Tables:

Table 11 Criteria for equipment trails in or around Class 4 stream RHCA. Limits are based on WEPP results.

	Sediment Buffer Width		Activity Area		Max Trail distance or activity allowed
A	First 100ft from stream edge has a slope between 0%-20%	Yes	Activity Area Slope < 35% or >35%?	<35%	600ft*
				>35%	Only Non-Ground Based Harvest and Prescribed Fire
		No	Go to B or C		
B	First 75ft from stream edge has a slope between 21%-35%	Yes	Activity Area Slope < 35% or >35%?	<35%	225ft*
		No		>35%	Only Non-Ground Based Harvest and Prescribed Fire
C	35% or more	Yes			Only Non-Ground Based Harvest and Prescribed Fire

* If the slope is broken by topography or water bars before the maximum trail length; potential of sediment to the stream is reduced.

Table 12 WEPP Data inputs and Results. Harvest felling does not seem to offer a sediment concern; however, this is not true for some propose yarding methods.

WEPP Run Combo	Soil Texture	Upper Element = Treatment [14]	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft)	Upper Cover (%)	Upper Rock (%)	Lower Element = Buffer[14]	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared [15]
Harvest Scenario (Loam)																	
1	loam	PG	60	60	1150	40	10	MF	40	5	50	100	10	0.0	10%	0.0	Harvest
2	loam	PG	60	60	1175	40	10	MF	40	5	25	100	10	0.0	10%	0.0	Harvest
3	loam	PG	60	60	1195	40	10	MF	40	5	5	100	10	0.2	10%	0.0	Harvest
4	loam	PG	60	60	1150	40	10	MF	50	5	50	100	10	0.0	10%	0.0	Harvest
5	loam	PG	60	60	1175	40	10	MF	50	5	25	100	10	0.0	10%	0.0	Harvest
6	loam	PG	60	60	1195	40	10	MF	50	5	5	100	10	0.2	10%	0.0	Harvest
7	loam	PG	60	60	1150	40	10	MF	60	5	50	100	10	0.0	10%	0.0	Harvest
8	loam	PG	60	60	1175	40	10	MF	60	5	25	100	10	0.1	10%	0.0	Harvest
9	loam	PG	60	60	1195	40	10	MF	60	5	5	100	10	0.2	10%	0.0	Harvest
10	loam	MF	60	60	1150	100	10	MF	40	5	50	100	10	0.0	0%	0.0	Harvest
11	loam	MF	60	60	1150	100	10	MF	50	5	50	100	10	0.0	0%	0.0	Harvest

[14] WEPP Treatment Codes: PG - Poor Grass (40%, EGC), MF - Mature Forest (100% EGC), ST - Skid Trail (10% EGC), HSF- High Severity Fire (45% EGC)

[15]Cell contains logic formula (=if(Delivery Average t/ac<0.03t/ac, True="Harvest" or "Trail", False="No Harvest" or "No Trail")

WEPP Run Combo	Soil Texture	Upper Element = Treatment [14]	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft)	Upper Cover (%)	Upper Rock (%)	Lower Element = Buffer [14]	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared [15]
12	loam	MF	60	60	1150	100	10	MF	60	5	50	100	10	0.0	0%	0.0	Harvest
Harvest Scenario (Silt Loam)																	
1	silt-loam	PG	60	60	1150	40	10	MF	40	5	50	100	10	0.0	10%	0.0	Harvest
2	silt-loam	PG	60	60	1175	40	10	MF	40	5	25	100	10	0.1	13%	0.0	Harvest
3	silt-loam	PG	60	60	1195	40	10	MF	40	5	5	100	10	0.4	13%	0.0	Harvest
4	silt-loam	PG	60	60	1150	40	10	MF	50	5	50	100	10	0.0	10%	0.0	Harvest
5	silt-loam	PG	60	60	1175	40	10	MF	50	5	25	100	10	0.1	13%	0.0	Harvest
6	silt-loam	PG	60	60	1195	40	10	MF	50	5	5	100	10	0.4	13%	0.0	Harvest
7	silt-loam	PG	60	60	1150	40	10	MF	60	5	50	100	10	0.0	10%	0.0	Harvest
8	silt-loam	PG	60	60	1175	40	10	MF	60	5	25	100	10	0.1	13%	0.0	Harvest
9	silt-loam	PG	60	60	1195	40	10	MF	60	5	5	100	10	0.5	13%	0.0	Harvest
10	silt-loam	MF	60	60	1150	100	10	MF	40	5	50	100	10	0.1	3%	0.0	Harvest
11	silt-loam	MF	60	60	1150	100	10	MF	50	5	50	100	10	0.1	3%	0.0	Harvest
12	silt-loam	MF	60	60	1150	100	10	MF	60	5	50	100	10	0.1	3%	0.0	Harvest
Harvest Scenario (Clay Loam)																	
1	clay-loam	PG	60	60	1150	40	10	MF	40	5	50	100	10	0.4	13%	0.0	Harvest
2	clay-loam	PG	60	60	1175	40	10	MF	40	5	25	100	10	0.5	13%	0.0	Harvest
3	clay-loam	PG	60	60	1195	40	10	MF	40	5	5	100	10	0.6	13%	0.0	Harvest
4	clay-loam	PG	60	60	1150	40	10	MF	50	5	50	100	10	0.4	13%	0.0	Harvest
5	clay-loam	PG	60	60	1175	40	10	MF	50	5	25	100	10	0.5	13%	0.0	Harvest
6	clay-loam	PG	60	60	1195	40	10	MF	50	5	5	100	10	0.6	13%	0.0	Harvest
7	clay-loam	PG	60	60	1150	40	10	MF	60	5	50	100	10	0.5	13%	0.0	Harvest
8	clay-loam	PG	60	60	1175	40	10	MF	60	5	25	100	10	0.5	13%	0.0	Harvest
9	clay-loam	PG	60	60	1195	40	10	MF	60	5	5	100	10	0.6	13%	0.0	Harvest
10	clay-loam	MF	60	60	1150	100	10	MF	40	5	50	100	10	0.0	3%	0.0	Harvest
11	clay-loam	MF	60	60	1150	100	10	MF	50	5	50	100	10	0.0	3%	0.0	Harvest
12	clay-loam	MF	60	60	1150	100	10	MF	60	5	50	100	10	0.0	3%	0.0	Harvest
Skid Trail Scenario (Loam)																	
1	Loam	ST	35	35	695	10	10	MF	10	5	5	100	10	6.0	67%	0.7	No Trail
2	Loam	ST	35	35	675	10	10	MF	10	5	25	100	10	4.1	43%	0.2	No Trail
3	Loam	ST	35	35	650	10	10	MF	10	5	50	100	10	2.4	30%	0.1	No Trail
4	Loam	ST	35	35	625	10	10	MF	10	5	75	100	10	1.0	20%	0.0	No Trail
5	Loam	ST	35	35	600	10	10	MF	10	5	100	100	10	0.3	10%	0.0	Trail
6	Loam	ST	35	35	695	10	10	MF	20	5	5	100	10	6.4	67%	0.8	No Trail

WEPP Run Combo	Soil Texture	Upper Element = Treatment [14]	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft)	Upper Cover (%)	Upper Rock (%)	Lower Element = Buffer [14]	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared [15]
7	Loam	ST	35	35	675	10	10	MF	20	5	25	100	10	4.8	43%	0.3	No Trail
8	Loam	ST	35	35	650	10	10	MF	20	5	50	100	10	3.4	33%	0.2	No Trail
9	Loam	ST	35	35	625	10	10	MF	20	5	75	100	10	1.8	20%	0.1	No Trail
10	Loam	ST	35	35	600	10	10	MF	20	5	100	100	10	0.6	13%	0.0	Trail
11	Loam	ST	35	35	695	10	10	MF	30	5	5	100	10	6.6	67%	0.9	No Trail
12	Loam	ST	35	35	675	10	10	MF	30	5	25	100	10	5.9	53%	0.4	No Trail
13	Loam	ST	35	35	650	10	10	MF	30	5	50	100	10	3.9	40%	0.2	No Trail
14	Loam	ST	35	35	625	10	10	MF	30	5	75	100	10	2.6	33%	0.1	No Trail
15	Loam	ST	35	35	600	10	10	MF	30	5	100	100	10	1.0	17%	0.0	No Trail
16	Loam	ST	35	35	695	10	10	MF	40	5	5	100	10	6.9	67%	0.9	No Trail
17	Loam	ST	35	35	675	10	10	MF	40	5	25	100	10	6.4	57%	0.5	No Trail
18	Loam	ST	35	35	650	10	10	MF	40	5	50	100	10	4.6	40%	0.3	No Trail
19	Loam	ST	35	35	625	10	10	MF	40	5	75	100	10	3.2	33%	0.2	No Trail
20	Loam	ST	35	35	600	10	10	MF	40	5	100	100	10	1.4	20%	0.1	No Trail
21	Loam	ST	35	35	295	10	10	MF	10	5	5	100	10	2.9	67%	0.4	No Trail
22	Loam	ST	35	35	275	10	10	MF	10	5	25	100	10	1.7	27%	0.1	No Trail
23	Loam	ST	35	35	250	10	10	MF	10	5	50	100	10	0.3	10%	0.0	Trail
24	Loam	ST	35	35	225	10	10	MF	10	5	75	100	10	0.0	3%	0.0	Trail
25	Loam	ST	35	35	200	10	10	MF	10	5	100	100	10	0.0	0%	0.0	Trail
26	Loam	ST	35	35	295	10	10	MF	20	5	5	100	10	3.1	67%	0.4	No Trail
27	Loam	ST	35	35	275	10	10	MF	20	5	25	100	10	2.2	33%	0.1	No Trail
28	Loam	ST	35	35	250	10	10	MF	20	5	50	100	10	0.4	10%	0.0	Trail
29	Loam	ST	35	35	225	10	10	MF	20	5	75	100	10	0.1	7%	0.0	Trail
30	Loam	ST	35	35	200	10	10	MF	20	5	100	100	10	0.0	0%	0.0	Trail
31	Loam	ST	35	35	295	10	10	MF	30	5	5	100	10	3.2	67%	0.5	No Trail
32	Loam	ST	35	35	275	10	10	MF	30	5	25	100	10	2.4	37%	0.2	No Trail
33	Loam	ST	35	35	250	10	10	MF	30	5	50	100	10	0.9	17%	0.0	No Trail
34	Loam	ST	35	35	225	10	10	MF	30	5	75	100	10	0.1	10%	0.0	Trail
35	Loam	ST	35	35	200	10	10	MF	30	5	100	100	10	0.1	7%	0.0	Trail
36	Loam	ST	35	35	295	10	10	MF	40	5	5	100	10	3.3	67%	0.5	No Trail
37	Loam	ST	35	35	275	10	10	MF	40	5	25	100	10	2.6	37%	0.2	No Trail
38	Loam	ST	35	35	250	10	10	MF	40	5	50	100	10	1.1	17%	0.0	No Trail
39	Loam	ST	35	35	225	10	10	MF	40	5	75	100	10	0.2	10%	0.0	Trail
40	Loam	ST	35	35	200	10	10	MF	40	5	100	100	10	0.1	7%	0.0	Trail

WEPP Run Combo	Soil Texture	Upper Element = Treatment [14]	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft)	Upper Cover (%)	Upper Rock (%)	Lower Element = Buffer[14]	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared [15]
41	Loam	MF	35	35	695	100	10	MF	10	5	5	100	10	0.0	0%	0.0	Trail
42	Loam	MF	35	35	695	100	10	MF	20	5	5	100	10	0.0	0%	0.0	Trail
43	Loam	MF	35	35	695	100	10	MF	30	5	5	100	10	0.0	0%	0.0	Trail
44	Loam	MF	35	35	695	100	10	MF	40	5	5	100	10	0.0	0%	0.0	Trail
45	Loam	MF	35	35	695	100	10	MF	50	5	5	100	10	0.0	0%	0.0	Trail
46	Loam	MF	35	35	695	100	10	MF	60	5	5	100	10	0.0	0%	0.0	Trail
47	Loam	MF	35	35	295	100	10	MF	10	5	5	100	10	0.0	0%	0.0	Trail
48	Loam	MF	35	35	295	100	10	MF	20	5	5	100	10	0.0	0%	0.0	Trail
49	Loam	MF	35	35	295	100	10	MF	30	5	5	100	10	0.0	0%	0.0	Trail
50	Loam	MF	35	35	295	100	10	MF	40	5	5	100	10	0.0	0%	0.0	Trail
51	Loam	MF	35	35	295	100	10	MF	50	5	5	100	10	0.0	0%	0.0	Trail
52	Loam	MF	35	35	295	100	10	MF	60	5	5	100	10	0.0	0%	0.0	Trail
Skid Trail Scenario (Silt Loam)																	
1	silt-loam	ST	35	35	695	10	10	MF	10	5	5	100	10	6.3	33%	0.5	No Trail
2	silt-loam	ST	35	35	675	10	10	MF	10	5	25	100	10	3.5	27%	0.2	No Trail
3	silt-loam	ST	35	35	650	10	10	MF	10	5	50	100	10	1.1	20%	0.0	No Trail
4	silt-loam	ST	35	35	625	10	10	MF	10	5	75	100	10	0.5	13%	0.0	Trail
5	silt-loam	ST	35	35	600	10	10	MF	10	5	100	100	10	0.3	10%	0.0	Trail
6	silt-loam	ST	35	35	695	10	10	MF	20	5	5	100	10	6.3	33%	0.5	No Trail
7	silt-loam	ST	35	35	675	10	10	MF	20	5	25	100	10	3.5	27%	0.2	No Trail
8	silt-loam	ST	35	35	650	10	10	MF	20	5	50	100	10	1.1	20%	0.0	No Trail
9	silt-loam	ST	35	35	625	10	10	MF	20	5	75	100	10	0.5	13%	0.0	Trail
10	silt-loam	ST	35	35	600	10	10	MF	20	5	100	100	10	0.3	10%	0.0	Trail
11	silt-loam	ST	35	35	695	10	10	MF	30	5	5	100	10	6.3	33%	0.5	No Trail
12	silt-loam	ST	35	35	675	10	10	MF	30	5	25	100	10	3.5	27%	0.2	No Trail
13	silt-loam	ST	35	35	650	10	10	MF	30	5	50	100	10	1.1	20%	0.0	No Trail
14	silt-loam	ST	35	35	625	10	10	MF	30	5	75	100	10	0.5	13%	0.0	Trail
15	silt-loam	ST	35	35	600	10	10	MF	30	5	100	100	10	0.3	10%	0.0	Trail
16	silt-loam	ST	35	35	695	10	10	MF	40	5	5	100	10	6.3	33%	0.5	No Trail
17	silt-loam	ST	35	35	675	10	10	MF	40	5	25	100	10	3.5	27%	0.2	No Trail
18	silt-loam	ST	35	35	650	10	10	MF	40	5	50	100	10	1.1	20%	0.0	No Trail
19	silt-loam	ST	35	35	625	10	10	MF	40	5	75	100	10	0.5	13%	0.0	Trail
20	silt-loam	ST	35	35	600	10	10	MF	40	5	100	100	10	0.3	10%	0.0	Trail
21	silt-loam	ST	35	35	295	10	10	MF	10	5	5	100	10	3.2	33%	0.3	No Trail

WEPP Run Combo	Soil Texture	Upper Element = Treatment [14]	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft)	Upper Cover (%)	Upper Rock (%)	Lower Element = Buffer[14]	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared [15]
22	silt-loam	ST	35	35	275	10	10	MF	10	5	25	100	10	1.3	17%	0.1	No Trail
23	silt-loam	ST	35	35	250	10	10	MF	10	5	50	100	10	0.3	7%	0.0	Trail
24	silt-loam	ST	35	35	225	10	10	MF	10	5	75	100	10	0.0	3%	0.0	Trail
25	silt-loam	ST	35	35	200	10	10	MF	10	5	100	100	10	0.0	0%	0.0	Trail
26	silt-loam	ST	35	35	295	10	10	MF	20	5	5	100	10	3.5	33%	0.3	No Trail
27	silt-loam	ST	35	35	275	10	10	MF	20	5	25	100	10	1.9	17%	0.1	No Trail
28	silt-loam	ST	35	35	250	10	10	MF	20	5	50	100	10	0.6	10%	0.0	Trail
29	silt-loam	ST	35	35	225	10	10	MF	20	5	75	100	10	0.0	3%	0.0	Trail
30	silt-loam	ST	35	35	200	10	10	MF	20	5	100	100	10	0.0	0%	0.0	Trail
31	silt-loam	ST	35	35	295	10	10	MF	30	5	5	100	10	3.6	33%	0.3	No Trail
32	silt-loam	ST	35	35	275	10	10	MF	30	5	25	100	10	2.3	17%	0.1	No Trail
33	silt-loam	ST	35	35	250	10	10	MF	30	5	50	100	10	0.8	10%	0.0	No Trail
34	silt-loam	ST	35	35	225	10	10	MF	30	5	75	100	10	0.0	3%	0.0	Trail
35	silt-loam	ST	35	35	200	10	10	MF	30	5	100	100	10	0.0	0%	0.0	Trail
36	silt-loam	ST	35	35	295	10	10	MF	40	5	5	100	10	3.8	33%	0.3	No Trail
37	silt-loam	ST	35	35	275	10	10	MF	40	5	25	100	10	2.5	17%	0.1	No Trail
38	silt-loam	ST	35	35	250	10	10	MF	40	5	50	100	10	0.9	10%	0.0	No Trail
39	silt-loam	ST	35	35	225	10	10	MF	40	5	75	100	10	0.0	3%	0.0	Trail
40	silt-loam	ST	35	35	200	10	10	MF	40	5	100	100	10	0.0	0%	0.0	Trail
41	silt-loam	MF	35	35	695	100	10	MF	10	5	5	100	10	0.0	3%	0.0	Trail
42	silt-loam	MF	35	35	695	100	10	MF	20	5	5	100	10	0.0	3%	0.0	Trail
43	silt-loam	MF	35	35	695	100	10	MF	30	5	5	100	10	0.0	3%	0.0	Trail
44	silt-loam	MF	35	35	695	100	10	MF	40	5	5	100	10	0.0	3%	0.0	Trail
45	silt-loam	MF	35	35	695	100	10	MF	50	5	5	100	10	0.0	3%	0.0	Trail
46	silt-loam	MF	35	35	695	100	10	MF	60	5	5	100	10	0.0	3%	0.0	Trail
47	silt-loam	MF	35	35	295	100	10	MF	10	5	5	100	10	0.0	0%	0.0	Trail
48	silt-loam	MF	35	35	295	100	10	MF	20	5	5	100	10	0.0	0%	0.0	Trail
49	silt-loam	MF	35	35	295	100	10	MF	30	5	5	100	10	0.0	0%	0.0	Trail
50	silt-loam	MF	35	35	295	100	10	MF	40	5	5	100	10	0.0	3%	0.0	Trail
51	silt-loam	MF	35	35	295	100	10	MF	50	5	5	100	10	0.0	3%	0.0	Trail
52	silt-loam	MF	35	35	295	100	10	MF	60	5	5	100	10	0.0	3%	0.0	Trail
Skid Trail Scenario (Clay Loam)																	
1	clay-loam	ST	35	35	695	10	10	MF	10	5	5	100	10	1.5	60%	0.2	No Trail
2	clay-loam	ST	35	35	675	10	10	MF	10	5	25	100	10	1.4	47%	0.1	No Trail

WEPP Run Combo	Soil Texture	Upper Element = Treatment [14]	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft)	Upper Cover (%)	Upper Rock (%)	Lower Element = Buffer[14]	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared [15]
3	clay-loam	ST	35	35	650	10	10	MF	10	5	50	100	10	1.3	33%	0.1	No Trail
4	clay-loam	ST	35	35	625	10	10	MF	10	5	75	100	10	1.0	27%	0.1	No Trail
5	clay-loam	ST	35	35	600	10	10	MF	10	5	100	100	10	0.7	30%	0.0	No Trail
5a	clay-loam	ST	35	35	600	20	10	MF	10	5	100	100	10	0.4	20%	0.0	Trail
5b	clay-loam	ST	35	35	600	30	10	MF	10	5	100	100	10	0.2	17%	0.0	Trail
6	clay-loam	ST	35	35	695	10	10	MF	20	5	5	100	10	1.6	60%	0.2	No Trail
7	clay-loam	ST	35	35	675	10	10	MF	20	5	25	100	10	1.5	47%	0.2	No Trail
8	clay-loam	ST	35	35	650	10	10	MF	20	5	50	100	10	1.4	33%	0.1	No Trail
9	clay-loam	ST	35	35	625	10	10	MF	20	5	75	100	10	1.3	30%	0.1	No Trail
10	clay-loam	ST	35	35	600	10	10	MF	20	5	100	100	10	0.9	23%	0.0	No Trail
10a	clay-loam	ST	35	35	600	20	10	MF	20	5	100	100	10	0.5	20%	0.0	Trail
10b	clay-loam	ST	35	35	600	30	10	MF	20	5	100	100	10	0.3	17%	0.0	Trail
11	clay-loam	ST	35	35	695	10	10	MF	30	5	5	100	10	1.6	60%	0.2	No Trail
12	clay-loam	ST	35	35	675	10	10	MF	30	5	25	100	10	1.5	47%	0.2	No Trail
13	clay-loam	ST	35	35	650	10	10	MF	30	5	50	100	10	1.4	37%	0.1	No Trail
14	clay-loam	ST	35	35	625	10	10	MF	30	5	75	100	10	1.3	30%	0.1	No Trail
15	clay-loam	ST	35	35	600	10	10	MF	30	5	100	100	10	0.9	27%	0.1	No Trail
15a	clay-loam	ST	35	35	600	20	10	MF	30	5	100	100	10	0.5	20%	0.0	No Trail
15b	clay-loam	ST	35	35	600	30	10	MF	30	5	100	100	10	0.3	17%	0.0	Trail
16	clay-loam	ST	35	35	695	10	10	MF	40	5	5	100	10	1.6	57%	0.2	No Trail
17	clay-loam	ST	35	35	675	10	10	MF	40	5	25	100	10	1.6	47%	0.2	No Trail
18	clay-loam	ST	35	35	650	10	10	MF	40	5	50	100	10	1.4	37%	0.1	No Trail
19	clay-loam	ST	35	35	625	10	10	MF	40	5	75	100	10	1.3	30%	0.1	No Trail
20	clay-loam	ST	35	35	600	10	10	MF	40	5	100	100	10	1.0	27%	0.1	No Trail
20a	clay-loam	ST	35	35	600	20	10	MF	40	5	100	100	10	0.5	20%	0.0	No Trail
20b	clay-loam	ST	35	35	600	30	10	MF	40	5	100	100	10	0.3	17%	0.0	Trail
21	clay-loam	ST	35	35	295	10	10	MF	10	5	5	100	10	1.0	57%	0.1	No Trail
22	clay-loam	ST	35	35	275	10	10	MF	10	5	25	100	10	0.8	37%	0.1	No Trail
23	clay-loam	ST	35	35	250	10	10	MF	10	5	50	100	10	0.6	23%	0.0	No Trail
24	clay-loam	ST	35	35	225	10	10	MF	10	5	75	100	10	0.3	13%	0.0	Trail
25	clay-loam	ST	35	35	200	10	10	MF	10	5	100	100	10	0.2	10%	0.0	Trail
26	clay-loam	ST	35	35	295	10	10	MF	20	5	5	100	10	1.0	57%	0.1	No Trail
27	clay-loam	ST	35	35	275	10	10	MF	20	5	25	100	10	0.8	37%	0.1	No Trail
28	clay-loam	ST	35	35	250	10	10	MF	20	5	50	100	10	0.6	20%	0.0	No Trail

WEPP Run Combo	Soil Texture	Upper Element = Treatment [14]	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft)	Upper Cover (%)	Upper Rock (%)	Lower Element = Buffer[14]	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared [15]
29	clay-loam	ST	35	35	225	10	10	MF	20	5	75	100	10	0.5	13%	0.0	Trail
30	clay-loam	ST	35	35	200	10	10	MF	20	5	100	100	10	0.2	10%	0.0	Trail
31	clay-loam	ST	35	35	295	10	10	MF	30	5	5	100	10	1.0	60%	0.1	No Trail
32	clay-loam	ST	35	35	275	10	10	MF	30	5	25	100	10	0.9	37%	0.1	No Trail
33	clay-loam	ST	35	35	250	10	10	MF	30	5	50	100	10	0.6	20%	0.0	No Trail
34	clay-loam	ST	35	35	225	10	10	MF	30	5	75	100	10	0.5	13%	0.0	Trail
35	clay-loam	ST	35	35	200	10	10	MF	30	5	100	100	10	0.3	10%	0.0	Trail
36	clay-loam	ST	35	35	295	10	10	MF	40	5	5	100	10	1.0	60%	0.1	No Trail
37	clay-loam	ST	35	35	275	10	10	MF	40	5	25	100	10	0.9	37%	0.1	No Trail
38	clay-loam	ST	35	35	250	10	10	MF	40	5	50	100	10	0.7	20%	0.0	No Trail
39	clay-loam	ST	35	35	225	10	10	MF	40	5	75	100	10	0.5	13%	0.0	Trail
40	clay-loam	ST	35	35	200	10	10	MF	40	5	100	100	10	0.3	10%	0.0	Trail
41	clay-loam	MF	35	35	695	100	10	MF	10	5	5	100	10	0.0	3%	0.0	Trail
42	clay-loam	MF	35	35	695	100	10	MF	20	5	5	100	10	0.0	3%	0.0	Trail
43	clay-loam	MF	35	35	695	100	10	MF	30	5	5	100	10	0.0	3%	0.0	Trail
44	clay-loam	MF	35	35	695	100	10	MF	40	5	5	100	10	0.0	3%	0.0	Trail
45	clay-loam	MF	35	35	695	100	10	MF	50	5	5	100	10	0.0	3%	0.0	Trail
46	clay-loam	MF	35	35	695	100	10	MF	60	5	5	100	10	0.0	3%	0.0	Trail
47	clay-loam	MF	35	35	295	100	10	MF	10	5	5	100	10	0.0	0%	0.0	Trail
48	clay-loam	MF	35	35	295	100	10	MF	20	5	5	100	10	0.0	0%	0.0	Trail
49	clay-loam	MF	35	35	295	100	10	MF	30	5	5	100	10	0.0	0%	0.0	Trail
50	clay-loam	MF	35	35	295	100	10	MF	40	5	5	100	10	0.0	0%	0.0	Trail
51	clay-loam	MF	35	35	295	100	10	MF	50	5	5	100	10	0.0	0%	0.0	Trail
52	clay-loam	MF	35	35	295	100	10	MF	60	5	5	100	10	0.0	3%	0.0	Trail
Wildfire Scenario (Loam)																	
1	loam	PG	60	60	1150	40	10	HSF	40	5	50	100	10	0.3	23%	0.0	Harvest
2	loam	PG	60	60	1175	40	10	HSF	40	5	25	100	10	0.3	23%	0.0	Harvest
3	loam	PG	60	60	1195	40	10	HSF	40	5	5	100	10	0.3	23%	0.0	Harvest
4	loam	PG	60	60	1150	40	10	HSF	50	5	50	100	10	0.3	23%	0.0	Harvest
5	loam	PG	60	60	1175	40	10	HSF	50	5	25	100	10	0.3	23%	0.0	Harvest
6	loam	PG	60	60	1195	40	10	HSF	50	5	5	100	10	0.3	23%	0.0	Harvest
7	loam	PG	60	60	1150	40	10	HSF	60	5	50	100	10	0.3	23%	0.0	Harvest
8	loam	PG	60	60	1175	40	10	HSF	60	5	25	100	10	0.3	23%	0.0	Harvest
9	loam	PG	60	60	1195	40	10	HSF	60	5	5	100	10	0.3	23%	0.0	Harvest

WEPP Run Combo	Soil Texture	Upper Element = Treatment [14]	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft)	Upper Cover (%)	Upper Rock (%)	Lower Element = Buffer[14]	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared [15]
Wildfire Scenario (Silt Loam)																	
1	silt-loam	PG	60	60	1150	40	10	HSF	40	5	50	45	10	0.1	10%	0.0	Harvest
2	silt-loam	PG	60	60	1175	40	10	HSF	40	5	25	45	10	0.1	10%	0.0	Harvest
3	silt-loam	PG	60	60	1195	40	10	HSF	40	5	5	45	10	0.1	10%	0.0	Harvest
4	silt-loam	PG	60	60	1150	40	10	HSF	50	5	50	45	10	0.1	10%	0.0	Harvest
5	silt-loam	PG	60	60	1175	40	10	HSF	50	5	25	45	10	0.1	10%	0.0	Harvest
6	silt-loam	PG	60	60	1195	40	10	HSF	50	5	5	45	10	0.1	10%	0.0	Harvest
7	silt-loam	PG	60	60	1150	40	10	HSF	60	5	50	45	10	0.2	10%	0.0	Harvest
8	silt-loam	PG	60	60	1175	40	10	HSF	60	5	25	45	10	0.2	10%	0.0	Harvest
9	silt-loam	PG	60	60	1195	40	10	HSF	60	5	5	45	10	0.1	10%	0.0	Harvest
Wildfire Scenario (Clay Loam)																	
1	clay-loam	PG	60	60	1150	40	10	HSF	40	5	50	45	10	0.6	17%	0.0	Harvest
2	clay-loam	PG	60	60	1175	40	10	HSF	40	5	25	45	10	0.6	17%	0.0	Harvest
3	clay-loam	PG	60	60	1195	40	10	HSF	40	5	5	45	10	0.6	17%	0.0	Harvest
4	clay-loam	PG	60	60	1150	40	10	HSF	50	5	50	45	10	0.6	17%	0.0	Harvest
5	clay-loam	PG	60	60	1175	40	10	HSF	50	5	25	45	10	0.6	17%	0.0	Harvest
6	clay-loam	PG	60	60	1195	40	10	HSF	50	5	5	45	10	0.6	17%	0.0	Harvest
7	clay-loam	PG	60	60	1150	40	10	HSF	60	5	50	45	10	0.6	17%	0.0	Harvest
8	clay-loam	PG	60	60	1175	40	10	HSF	60	5	25	45	10	0.6	17%	0.0	Harvest
9	clay-loam	PG	60	60	1195	40	10	HSF	60	5	5	45	10	0.6	17%	0.0	Harvest
Wildfire Skid Trail Scenario (Loam)																	
1	Loam	ST	35	35	695	10	10	HSF	35	5	5	45	10	1.3	57%	0.1	No Trail
2	Loam	ST	35	35	675	10	10	HSF	35	5	25	45	10	1.2	57%	0.1	No Trail
3	Loam	ST	35	35	650	10	10	HSF	35	5	50	45	10	1.2	53%	0.1	No Trail
4	Loam	ST	35	35	625	10	10	HSF	35	5	75	45	10	1.2	53%	0.1	No Trail
5	Loam	ST	35	35	600	10	10	HSF	35	5	100	45	10	1.1	50%	0.1	No Trail
6	Loam	ST	35	35	575	10	10	HSF	35	5	125	45	10	1.1	43%	0.1	No Trail
7	Loam	ST	35	35	550	10	10	HSF	35	5	150	45	10	1.1	43%	0.1	No Trail
8	Loam	ST	35	35	525	10	10	HSF	35	5	175	45	10	1.9	43%	0.1	No Trail
9	Loam	ST	35	35	500	10	10	HSF	35	5	200	45	10	1.1	40%	0.1	No Trail
10	Loam	ST	35	35	475	10	10	HSF	35	5	225	45	10	0.9	37%	0.1	No Trail
11	Loam	ST	35	35	450	10	10	HSF	35	5	250	45	10	0.9	37%	0.1	No Trail
12	Loam	ST	35	35	425	10	10	HSF	35	5	275	45	10	0.8	33%	0.1	No Trail
13	Loam	ST	35	35	400	10	10	HSF	35	5	300	45	10	0.7	33%	0.1	No Trail

WEPP Run Combo	Soil Texture	Upper Element = Treatment [14]	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft)	Upper Cover (%)	Upper Rock (%)	Lower Element = Buffer[14]	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared [15]
14	Loam	ST	35	35	375	10	10	HSF	35	5	325	45	10	0.6	33%	0.1	No Trail
15	Loam	ST	35	35	350	10	10	HSF	35	5	350	45	10	0.5	30%	0.0	No Trail
16	Loam	ST	35	35	325	10	10	HSF	35	5	375	45	10	0.4	30%	0.0	No Trail
17	Loam	ST	35	35	300	10	10	HSF	35	5	400	45	10	0.2	23%	0.0	Trail
Wildfire Skid Trail Scenario (Silt Loam)																	
1	silt-loam	ST	35	35	695	10	10	HSF	35	5	5	45	10	1.7	40%	0.1	No Trail
2	silt-loam	ST	35	35	675	10	10	HSF	35	5	25	45	10	1.6	30%	0.1	No Trail
3	silt-loam	ST	35	35	650	10	10	HSF	35	5	50	45	10	1.6	30%	0.1	No Trail
4	silt-loam	ST	35	35	625	10	10	HSF	35	5	75	45	10	1.5	30%	0.1	No Trail
5	silt-loam	ST	35	35	600	10	10	HSF	35	5	100	45	10	1.5	27%	0.1	No Trail
6	silt-loam	ST	35	35	575	10	10	HSF	35	5	125	45	10	1.4	27%	0.1	No Trail
7	silt-loam	ST	35	35	550	10	10	HSF	35	5	150	45	10	1.3	27%	0.1	No Trail
8	silt-loam	ST	35	35	525	10	10	HSF	35	5	175	45	10	1.2	27%	0.1	No Trail
9	silt-loam	ST	35	35	500	10	10	HSF	35	5	200	45	10	0.9	27%	0.1	No Trail
10	silt-loam	ST	35	35	475	10	10	HSF	35	5	225	45	10	0.8	27%	0.0	No Trail
11	silt-loam	ST	35	35	450	10	10	HSF	35	5	250	45	10	0.7	27%	0.0	No Trail
12	silt-loam	ST	35	35	425	10	10	HSF	35	5	275	45	10	0.7	27%	0.0	No Trail
13	silt-loam	ST	35	35	400	10	10	HSF	35	5	300	45	10	0.6	27%	0.4	No Trail
14	silt-loam	ST	35	35	375	10	10	HSF	35	5	325	45	10	0.6	27%	0.0	No Trail
15	silt-loam	ST	35	35	350	10	10	HSF	35	5	350	45	10	0.5	23%	0.0	No Trail
16	silt-loam	ST	35	35	325	10	10	HSF	35	5	375	45	10	0.5	20%	0.0	Trail
Wildfire Skid Trail Scenario (Clay Loam)																	
1	clay-loam	ST	35	35	695	10	10	HSF	35	5	5	45	10	1.6	80%	0.2	No Trail
2	clay-loam	ST	35	35	675	10	10	HSF	35	5	25	45	10	1.6	80%	0.2	No Trail
3	clay-loam	ST	35	35	650	10	10	HSF	35	5	50	45	10	1.5	77%	0.2	No Trail
4	clay-loam	ST	35	35	625	10	10	HSF	35	5	75	45	10	1.4	70%	0.2	No Trail
5	clay-loam	ST	35	35	600	10	10	HSF	35	5	100	45	10	1.4	63%	0.2	No Trail
6	clay-loam	ST	35	35	575	10	10	HSF	35	5	125	45	10	1.3	53%	0.2	No Trail
7	clay-loam	ST	35	35	550	10	10	HSF	35	5	150	45	10	1.2	53%	0.1	No Trail
8	clay-loam	ST	35	35	525	10	10	HSF	35	5	175	45	10	1.2	50%	0.1	No Trail
9	clay-loam	ST	35	35	500	10	10	HSF	35	5	200	45	10	1.2	50%	0.1	No Trail
10	clay-loam	ST	35	35	475	10	10	HSF	35	5	225	45	10	1.0	47%	0.1	No Trail
11	clay-loam	ST	35	35	450	10	10	HSF	35	5	250	45	10	0.9	43%	0.1	No Trail
12	clay-loam	ST	35	35	425	10	10	HSF	35	5	275	45	10	0.6	43%	0.1	No Trail

WEPP Run Combo	Soil Texture	Upper Element = Treatment [14]	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft)	Upper Cover (%)	Upper Rock (%)	Lower Element = Buffer[14]	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared [15]
13	clay-loam	ST	35	35	400	10	10	HSF	35	5	300	45	10	0.5	40%	0.1	No Trail
14	clay-loam	ST	35	35	375	10	10	HSF	35	5	325	45	10	0.5	37%	0.1	No Trail
15	clay-loam	ST	35	35	350	10	10	HSF	35	5	350	45	10	0.5	37%	0.1	No Trail
16	clay-loam	ST	35	35	325	10	10	HSF	35	5	375	45	10	0.4	37%	0.0	No Trail
17	clay-loam	ST	35	35	300	10	10	HSF	35	5	400	45	10	0.4	37%	0.0	No Trail
18	clay-loam	ST	35	35	275	10	10	HSF	35	5	425	45	10	0.3	37%	0.0	No Trail
19	clay-loam	ST	35	35	250	10	10	HSF	35	5	450	45	10	0.3	33%	0.0	No Trail
20	clay-loam	ST	35	35	225	10	10	HSF	35	5	475	45	10	0.3	33%	0.0	Trail
21	clay-loam	ST	35	35	200	10	10	HSF	35	5	500	45	10	0.3	30%	0.0	Trail

Table 13 DSC estimates and calculations. Detrimental estimates are based on previous monitoring of various harvest systems, Helicopter = 1% DSC, Skyline = 5% DSC, Ground Based Systems = 10%, Prescribed Burning = 1% DSC. Each of these DSC estimates has a different effective duration on the landscape.

Unit	Alt 2 Harvest System Proposed	Alt 2 Acres	Alt 3 Harvest System Proposed	Alt 3 Acres	Alt 4 Harvest System Proposed	Alt 4Acres	DSC Alt 1 Acres Observed	ALT 2 Est. DSC (Ac*3%)	ALT 3 Est. DSC (Ac*3%)	ALT 4 Est. DSC (Ac*3%)	Alt 2 Expected DSC[16]	Alt 3 Expected DSC[16]	Alt 4 Expected DSC[16]	Alt 2 Expect Cumulative DSC[17]	Alt 3 Expect Cumulative DSC[17]	Alt 4 Expect Cumulative DSC[17]	Alt 2 Cumulative DSC%	Alt 3 Cumulative DSC%
1	GB	82.9	GB	82.9	GB	77.1	0.7				9.8	9.8	9.2	10.5	10.5	9.9	13%	13%
2	GB	38.2	GB	38.2	GB	33.8		1.1	1.1	1.0	5.3	5.3	4.7	5.3	5.3	4.7	14%	14%
2a	GB	73.7		0.0		0.0	0.4				8.5	0.0	0.0	8.9	0.4	0.4	12%	0%
3	GB	48.6	GB	48.6	GB	48.6	0.2				5.5	5.5	5.5	5.7	5.7	5.7	12%	12%
3a	GB	77.7	GB	77.7	GB	77.3	0.3				8.8	8.8	8.8	9.1	9.1	9.1	12%	12%
3b	GB	62.8	GB	62.8	GB	62.3	1.1				8.0	8.0	8.0	9.1	9.1	9.1	15%	15%
4	GB	19.5	GB	19.5	GB	19.5		0.6	0.6	0.6	2.7	2.7	2.7	2.7	2.7	2.7	14%	14%
4b	GB	102.7	GB	102.7	GB	102.7	0.4				11.7	11.7	11.7	12.1	12.1	12.1	12%	12%
5	GB	32.3	GB	0.0	GB	0.0		1.0	0.0	0.0	4.5	0.0	0.0	4.5	0.0	0.0	14%	0%
5a	GB	0.3	GB	0.3		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14%	14%
6	GB	86.5		0.0		0.0		2.6	0.0	0.0	12.1	0.0	0.0	12.1	0.0	0.0	14%	0%
7	GB	53.8		0.0		0.0		1.6	0.0	0.0	7.5	0.0	0.0	7.5	0.0	0.0	14%	0%
7a	GB	7.8	GB	7.8	GB	6.6		0.2	0.2	0.2	1.1	1.1	0.9	1.1	1.1	0.9	14%	14%
8	GB	31.2	GB	31.2	GB	30.1	0.2				3.6	3.6	3.5	3.8	3.8	3.7	12%	12%
9	GB	37.2	GB	37.2	GB	36.3	0.0				4.1	4.1	4.0	4.1	4.1	4.0	11%	11%
10	GB	14.0	GB	14.0	GB	14.0		0.4	0.4	0.4	2.0	2.0	2.0	2.0	2.0	2.0	14%	14%
10a	GB	18.1					0.0				2.0	0.0	0.0	2.0	0.0	0.0	11%	0%
10b	GB	24.1						0.7	0.0	0.0	3.4	0.0	0.0	3.4	0.0	0.0	14%	0%
11	GB	127.7	GB	127.7	GB	121.5		3.8	3.8	3.6	17.9	17.9	17.0	17.9	17.9	17.0	14%	14%
11b	GB	120.4	GB	120.4	GB	111.0		3.6	3.6	3.3	16.9	16.9	15.5	16.9	16.9	15.5	14%	14%
12	GB	59.1	GB	59.1	GB	57.5	0.3				6.8	6.8	6.6	7.1	7.1	6.9	12%	12%
12a	GB	73.9		73.9		73.5		2.2	2.2	2.2	10.3	0.0	0.0	10.3	0.0	0.0	14%	0%
13	GB	42.3	GB	42.3	GB	42.0		1.3	1.3	1.3	5.9	5.9	5.9	5.9	5.9	5.9	14%	14%
13a	GB	14.7	GB	14.7	GB	14.7		0.4	0.4	0.4	2.1	2.1	2.1	2.1	2.1	2.1	14%	14%
13b	GB	36.4	GB	36.4	GB	35.6		1.1	1.1	1.1	5.1	5.1	5.0	5.1	5.1	5.0	14%	14%
14	GB	257.5	GB	257.5	GB	246.3	1.4				29.7	29.7	28.5	31.1	31.1	29.9	12%	12%
15	GB	87.5	GB	87.5	GB	84.6		2.6	2.6	2.5	12.3	12.3	11.8	12.3	12.3	11.8	14%	14%
16	GB	100.1	GB	100.1	GB	97.8		3.0	3.0	2.9	14.0	14.0	13.7	14.0	14.0	13.7	14%	14%

[16] DSC = Harvest System DSC% * unit acres

[17] DSC = Observe DSC+ Alt X Estimated DSC

Unit	Alt 2 Harvest System Proposed	Alt 2 Acres	Alt 3 Harvest System Proposed	Alt 3 Acres	Alt 4 Harvest System Proposed	Alt 4Acres	DSC Alt 1 Acres Observed	ALT 2 Est. DSC (Ac*3%)	ALT 3 Est. DSC (Ac*3%)	ALT 4 Est. DSC (Ac*3%)	Alt 2 Expected DSC[16]	Alt 3 Expected DSC[16]	Alt 4 Expected DSC[16]	Alt 2 Expect Cumulative DSC[17]	Alt 3 Expect Cumulative DSC[17]	Alt 4 Expect Cumulative DSC[17]	Alt 2 Cumulative DSC%	Alt 3 Cumulative DSC%
17	GB	245.2	GB	245.2	GB	223.0		7.4	7.4	6.7	34.3	34.3	31.2	34.3	34.3	31.2	14%	14%
18	GB	149.5	GB	149.5	GB	148.7		4.5	4.5	4.5	20.9	20.9	20.8	20.9	20.9	20.8	14%	14%
18a	GB	74.1	GB	74.1	GB	68.9		2.2	2.2	2.1	10.4	10.4	9.6	10.4	10.4	9.6	14%	14%
18b	GB	53.9	GB	53.9	GB	51.9		1.6	1.6	1.6	7.5	7.5	7.3	7.5	7.5	7.3	14%	14%
19	GB	249.6	GB	249.6	GB	246.9		7.5	7.5	7.4	34.9	34.9	34.6	34.9	34.9	34.6	14%	14%
20	GB	31.5	GB	31.5	GB	26.6		0.9	0.9	0.8	4.4	4.4	3.7	4.4	4.4	3.7	14%	14%
20a	GB	16.3	GB	16.3	GB	14.5		0.5	0.5	0.4	2.3	2.3	2.0	2.3	2.3	2.0	14%	14%
21	GB	72.4	GB	72.4	GB	66.3		2.2	2.2	2.0	10.1	10.1	9.3	10.1	10.1	9.3	14%	14%
21a	GB	40.2	GB	40.2	GB	40.2		1.2	1.2	1.2	5.6	5.6	5.6	5.6	5.6	5.6	14%	14%
21b	GB	81.8	GB	81.8	GB	81.5		2.5	2.5	2.4	11.5	11.5	11.4	11.5	11.5	11.4	14%	14%
21c	GB	14.3	GB	14.3	GB	14.3		0.4	0.4	0.4	2.0	2.0	2.0	2.0	2.0	2.0	14%	14%
21d	GB	11.0	GB	11.0	GB	11.0		0.3	0.3	0.3	1.5	1.5	1.5	1.5	1.5	1.5	14%	14%
21e	GB	32.0	GB	32.0	GB	32.0		1.0	1.0	1.0	4.5	4.5	4.5	4.5	4.5	4.5	14%	14%
21f	GB	36.7						1.1	0.0	0.0	5.1	0.0	0.0	5.1	0.0	0.0	14%	0%
21g	GB	49.7	GB	49.7	GB	47.1		1.5	1.5	1.4	7.0	7.0	6.6	7.0	7.0	6.6	14%	14%
22	GB	331.2	GB	331.2	GB	299.1		9.9	9.9	9.0	46.4	46.4	41.9	46.4	46.4	41.9	14%	14%
23	GB	122.6	GB	122.6	GB	119.2		3.7	3.7	3.6	17.2	17.2	16.7	17.2	17.2	16.7	14%	14%
23a	GB	53.3	GB	53.3	GB	48.9		1.6	1.6	1.5	7.5	7.5	6.8	7.5	7.5	6.8	14%	14%
23b	GB	46.1						1.4	0.0	0.0	6.5	0.0	0.0	6.5	0.0	0.0	14%	0%
23c	GB	79.2	GB	79.2	GB	79.2		2.4	2.4	2.4	11.1	11.1	11.1	11.1	11.1	11.1	14%	14%
24	GB	71.0	GB	71.0	GB	68.6	0.0				7.8	7.8	7.5	7.8	7.8	7.5	11%	11%
24a	GB	50.1	GB	50.1	GB	50.1	0.8				6.3	6.3	6.3	7.1	7.1	7.1	14%	14%
24b	GB	23.8	GB	23.8	GB	23.8		0.7	0.7	0.7	3.3	3.3	3.3	3.3	3.3	3.3	14%	14%
25	GB	24.6	GB	24.6	GB	24.6	0.2	0.7			3.6	2.9	2.9	3.8	3.1	3.1	16%	13%
26	GB	116.4	GB	116.4	GB	116.4	0.3	3.5			16.6	13.1	13.1	16.9	13.4	13.4	15%	12%
26a	GB	47.6	GB	47.6	GB	47.6		1.4	1.4	1.4	6.7	6.7	6.7	6.7	6.7	6.7	14%	14%
27	GB	208.6	GB	208.6	GB	195.9		6.3	6.3	5.9	29.2	29.2	27.4	29.2	29.2	27.4	14%	14%
27a	GB	27.5	GB	27.5	GB	27.0		0.8	0.8	0.8	3.9	3.9	3.8	3.9	3.9	3.8	14%	14%
27b	GB	61.3	GB	61.3	GB	61.3		1.8	1.8	1.8	8.6	8.6	8.6	8.6	8.6	8.6	14%	14%
27c	GB	17.3	GB	17.3	GB	3.6		0.5	0.5	0.1	2.4	2.4	0.5	2.4	2.4	0.5	14%	14%
28	Sky	33.8	Sky	33.8	Sky	33.8		1.0	1.0	1.0	2.7	2.7	2.7	2.7	2.7	2.7	8%	8%
28a	GB	189.5	GB	189.5	GB	189.5		5.7	5.7	5.7	26.5	26.5	26.5	26.5	26.5	26.5	14%	14%

Unit	Alt 2 Harvest System Proposed	Alt 2 Acres	Alt 3 Harvest System Proposed	Alt 3 Acres	Alt 4 Harvest System Proposed	Alt 4Acres	DSC Alt 1 Acres Observed	ALT 2 Est. DSC (Ac*3%)	ALT 3 Est. DSC (Ac*3%)	ALT 4 Est. DSC (Ac*3%)	Alt 2 Expected DSC[16]	Alt 3 Expected DSC[16]	Alt 4 Expected DSC[16]	Alt 2 Expect Cumulative DSC[17]	Alt 3 Expect Cumulative DSC[17]	Alt 4 Expect Cumulative DSC[17]	Alt 2 Cumulative DSC%	Alt 3 Cumulative DSC%
29	GB	68.4	GB	68.4	GB	68.0		2.1	2.1	2.0	9.6	9.6	9.5	9.6	9.6	9.5	14%	14%
30	GB	16.7	GB	16.7	GB	16.7		0.5	0.5	0.5	2.3	2.3	2.3	2.3	2.3	2.3	14%	14%
30a	GB	28.7						0.9	0.0	0.0	4.0	0.0	0.0	4.0	0.0	0.0	14%	0%
31	GB	96.0	GB	96.0	GB	79.4		2.9	2.9	2.4	13.4	13.4	11.1	13.4	13.4	11.1	14%	14%
31a	GB	46.7	GB	46.7	GB	43.5		1.4	1.4	1.3	6.5	6.5	6.1	6.5	6.5	6.1	14%	14%
31b	GB	60.3	GB	60.3	GB	53.6		1.8	1.8	1.6	8.4	8.4	7.5	8.4	8.4	7.5	14%	14%
32	Sky	51.4	Sky	51.4	Sky	32.8		1.5	1.5	1.0	4.1	4.1	2.6	4.1	4.1	2.6	8%	8%
33	Heli	16.3	Heli	16.3	Heli	15.6		0.5	0.5	0.5	0.8	0.8	0.8	0.8	0.8	0.8	5%	5%
34	Heli	12.8	Heli	12.8	Heli	12.8		0.4	0.4	0.4	0.6	0.6	0.6	0.6	0.6	0.6	5%	5%
35	Heli	69.2	Heli	69.2				2.1	2.1	0.0	3.5	3.5	0.0	3.5	3.5	0.0	5%	5%
36	Heli	25.9	Heli	25.9	Heli	25.8		0.8	0.8	0.8	1.3	1.3	1.3	1.3	1.3	1.3	5%	5%
36a	Heli	23.9	Heli	23.9	Heli	23.9		0.7	0.7	0.7	1.2	1.2	1.2	1.2	1.2	1.2	5%	5%
36b	Heli	29.4	Heli	29.4	Heli	29.1		0.9	0.9	0.9	1.5	1.5	1.5	1.5	1.5	1.5	5%	5%
37	Heli	59.6	Heli	59.6	Heli			1.8	1.8	0.0	3.0	3.0	0.0	3.0	3.0	0.0	5%	5%
38	Heli	19.9	Heli	19.9	Heli	19.7		0.6	0.6	0.6	1.0	1.0	1.0	1.0	1.0	1.0	5%	5%
39	Heli	17.5	Heli	17.5	Heli	17.5		0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	5%	5%
40	Sky	24.3	Sky	24.3				0.7	0.7	0.0	1.9	1.9	0.0	1.9	1.9	0.0	8%	8%
40a	GB	15.0	GB	15.0	GB	15.0		0.5	0.5	0.5	2.1	2.1	2.1	2.1	2.1	2.1	14%	14%
40b	GB	18.2	GB	18.2	GB	16.3		0.5	0.5	0.5	2.5	2.5	2.3	2.5	2.5	2.3	14%	14%
40c	Sky	46.9	Sky	46.9	Sky	32.9		1.4	1.4	1.0	3.8	3.8	2.6	3.8	3.8	2.6	8%	8%
41	Heli	74.9	Heli	74.9	Heli	70.6		2.2	2.2	2.1	3.7	3.7	3.5	3.7	3.7	3.5	5%	5%
41a	Sky	59.1	Sky	59.1	Sky	47.5		1.8	1.8	1.4	4.7	4.7	3.8	4.7	4.7	3.8	8%	8%
42	Sky	24.6	Sky	24.6	Sky	24.6		0.7	0.7	0.7	2.0	2.0	2.0	2.0	2.0	2.0	8%	8%
42a	GB	21.8	GB	21.8	GB	21.8		0.7	0.7	0.7	3.1	3.1	3.1	3.1	3.1	3.1	14%	14%
42b	GB	46.0	GB	46.0	GB	46.0		1.4	1.4	1.4	6.4	6.4	6.4	6.4	6.4	6.4	14%	14%
42c	Sky	9.2	Sky	9.2	Sky	9.2		0.3	0.3	0.3	0.7	0.7	0.7	0.7	0.7	0.7	8%	8%
42d	GB	12.9	GB	12.9	GB	12.9		0.4	0.4	0.4	1.8	1.8	1.8	1.8	1.8	1.8	14%	14%
42e	Sky	9.0	Sky	9.0	Sky	9.0		0.3	0.3	0.3	0.7	0.7	0.7	0.7	0.7	0.7	8%	8%
43	GB	41.9	GB	41.9	GB	39.4		1.3	1.3	1.2	5.9	5.9	5.5	5.9	5.9	5.5	14%	14%
43	Heli	31.7	Heli	31.7	Heli	21.8		1.0	1.0	0.7	1.6	1.6	1.1	1.6	1.6	1.1	5%	5%
43a	GB	423.5	GB	423.5	GB	389.9		12.7	12.7	11.7	59.3	59.3	54.6	59.3	59.3	54.6	14%	14%
44	Heli	13.7	Heli	13.7				0.4	0.4	0.0	0.7	0.7	0.0	0.7	0.7	0.0	5%	5%

Unit	Alt 2 Harvest System Proposed	Alt 2 Acres	Alt 3 Harvest System Proposed	Alt 3 Acres	Alt 4 Harvest System Proposed	Alt 4Acres	DSC Alt 1 Acres Observed	ALT 2 Est. DSC (Ac*3%)	ALT 3 Est. DSC (Ac*3%)	ALT 4 Est. DSC (Ac*3%)	Alt 2 Expected DSC[16]	Alt 3 Expected DSC[16]	Alt 4 Expected DSC[16]	Alt 2 Expect Cumulative DSC[17]	Alt 3 Expect Cumulative DSC[17]	Alt 4 Expect Cumulative DSC[17]	Alt 2 Cumulative DSC%	Alt 3 Cumulative DSC%
45	GB	37.3	GB	37.3	GB	37.3		1.1	1.1	1.1	5.2	5.2	5.2	5.2	5.2	5.2	14%	14%
46	GB	68.8	GB	68.8	GB	68.8		2.1	2.1	2.1	9.6	9.6	9.6	9.6	9.6	9.6	14%	14%
47	Sky	7.3	Sky	7.3	Sky	6.4		0.2	0.2	0.2	0.6	0.6	0.5	0.6	0.6	0.5	8%	8%
48	Sky	9.8	Sky	9.8	Sky	9.7		0.3	0.3	0.3	0.8	0.8	0.8	0.8	0.8	0.8	8%	8%
49	Sky	30.7	Sky	30.7	Sky	30.7		0.9	0.9	0.9	2.5	2.5	2.5	2.5	2.5	2.5	8%	8%
49a	GB	15.8	GB	15.8	GB	15.8		0.5	0.5	0.5	2.2	2.2	2.2	2.2	2.2	2.2	14%	14%
49b	Sky	19.6	Sky	19.6				0.6	0.6	0.0	1.6	1.6	0.0	1.6	1.6	0.0	8%	8%
50	Sky	25.7	Sky	25.7	Sky	24.8		0.8	0.8	0.7	2.1	2.1	2.0	2.1	2.1	2.0	8%	8%
51	GB	16.0	GB	16.0	GB	16.0		0.5	0.5	0.5	2.2	2.2	2.2	2.2	2.2	2.2	14%	14%
51a	GB	24.0	GB	24.0	GB	24.0		0.7	0.7	0.7	3.4	3.4	3.4	3.4	3.4	3.4	14%	14%
52	GB	57.6	GB	57.6	GB	57.6		1.7	1.7	1.7	8.1	8.1	8.1	8.1	8.1	8.1	14%	14%
53	GB	172.4	GB	172.4	GB	151.4		5.2	5.2	4.5	24.1	24.1	21.2	24.1	24.1	21.2	14%	14%
53a	GB	26.9	GB	26.9	GB	26.9		0.8	0.8	0.8	3.8	3.8	3.8	3.8	3.8	3.8	14%	14%
53b	GB	27.6	GB	27.6	GB	27.6		0.8	0.8	0.8	3.9	3.9	3.9	3.9	3.9	3.9	14%	14%
53c	Heli	22.0						0.7	0.0	0.0	1.1	0.0	0.0	1.1	0.0	0.0	5%	0%
53d	Sky	21.8						0.7	0.0	0.0	1.7	0.0	0.0	1.7	0.0	0.0	8%	0%
54	GB	80.4	GB	80.4	GB	75.2	0.0				8.8	8.8	8.3	8.8	8.8	8.3	11%	11%
55	Sky	23.1	Sky	23.1	GB	23.1		0.7	0.7	0.7	1.8	1.8	3.2	1.8	1.8	3.2	8%	8%
56	Sky	30.5	Sky	30.5				0.9	0.9	0.0	2.4	2.4	0.0	2.4	2.4	0.0	8%	8%
56a	GB	110.1	GB	110.1	GB	105.5		3.3	3.3	3.2	15.4	15.4	14.8	15.4	15.4	14.8	14%	14%
57	Sky	11.8	Sky	11.8	Sky	11.8		0.4	0.4	0.4	0.9	0.9	0.9	0.9	0.9	0.9	8%	8%
57a	GB	122.1	GB	122.1	GB	116.5		3.7	3.7	3.5	17.1	17.1	16.3	17.1	17.1	16.3	14%	14%
57b	GB	32.5	GB	32.5	GB	32.5		1.0	1.0	1.0	4.6	4.6	4.6	4.6	4.6	4.6	14%	14%
58	GB	105.6	Sky	105.6	Sky	99.9		3.2	3.2	3.0	14.8	8.4	8.0	14.8	8.4	8.0	14%	8%
59	GB	26.6	GB	26.6	GB	26.3		0.8	0.8	0.8	3.7	3.7	3.7	3.7	3.7	3.7	14%	14%
60	GB	18.6	GB	18.6	GB	18.6		0.6	0.6	0.6	2.6	2.6	2.6	2.6	2.6	2.6	14%	14%
60a	Heli	57.7	Heli	57.7				1.7	1.7	0.0	2.9	2.9	0.0	2.9	2.9	0.0	5%	5%
60b	Sky	9.5	Sky	9.5	Sky	9.5		0.3	0.3	0.3	0.8	0.8	0.8	0.8	0.8	0.8	8%	8%
61	GB	64.2	GB	64.2	GB	64.2		1.9	1.9	1.9	9.0	9.0	9.0	9.0	9.0	9.0	14%	14%
61a	Sky	10.7	Sky	10.7	Sky	10.7		0.3	0.3	0.3	0.9	0.9	0.9	0.9	0.9	0.9	8%	8%
62	Sky	37.4	Sky	37.4	Sky	37.4		1.1	1.1	1.1	3.0	3.0	3.0	3.0	3.0	3.0	8%	8%
63	Sky	48.2	Sky	48.2	Sky	48.2		1.4	1.4	1.4	3.9	3.9	3.9	3.9	3.9	3.9	8%	8%

Unit	Alt 2 Harvest System Proposed	Alt 2 Acres	Alt 3 Harvest System Proposed	Alt 3 Acres	Alt 4 Harvest System Proposed	Alt 4Acres	DSC Alt 1 Acres Observed	ALT 2 Est. DSC (Ac*3%)	ALT 3 Est. DSC (Ac*3%)	ALT 4 Est. DSC (Ac*3%)	Alt 2 Expected DSC[16]	Alt 3 Expected DSC[16]	Alt 4 Expected DSC[16]	Alt 2 Expect Cumulative DSC[17]	Alt 3 Expect Cumulative DSC[17]	Alt 4 Expect Cumulative DSC[17]	Alt 2 Cumulative DSC%	Alt 3 Cumulative DSC%
65	GB	88.7	GB	88.7	GB	87.6	0.2				10.0	10.0	9.8	10.2	10.2	10.0	11%	11%
65a	GB	49.2	GB	49.2	GB	49.2		1.5	1.5	1.5	6.9	6.9	6.9	6.9	6.9	6.9	14%	14%
65b	GB	47.0						1.4	0.0	0.0	6.6	0.0	0.0	6.6	0.0	0.0	14%	0%
67	NCT	28.9	NCT	28.9	NCT	16.8		0.9	0.9	0.5	1.2	1.2	0.7	1.2	1.2	0.7	4%	4%
68	GB	243.3	GB	243.3	GB	240.1		7.3	7.3	7.2	34.1	34.1	33.6	34.1	34.1	33.6	14%	14%
68a	Sky	16.6	Sky	16.6	Sky	11.4		0.5	0.5	0.3	1.3	1.3	0.9	1.3	1.3	0.9	8%	8%
68b	Sky	48.7	Sky	48.7	Sky	48.7		1.5	1.5	1.5	3.9	3.9	3.9	3.9	3.9	3.9	8%	8%
68c	Heli	26.7						0.8	0.0	0.0	1.3	0.0	0.0	1.3	0.0	0.0	5%	0%
68d	NCT	47.6	NCT	47.6	NCT	47.6		1.4	1.4	1.4	1.9	1.9	1.9	1.9	1.9	1.9	4%	4%
69	GB	43.4	GB	43.4	GB	41.1		1.3	1.3	1.2	6.1	6.1	5.8	6.1	6.1	5.8	14%	14%
69a	GB	94.0	GB	94.0	GB	93.5		2.8	2.8	2.8	13.2	13.2	13.1	13.2	13.2	13.1	14%	14%
69b	NCT	8.4	NCT	8.4	NCT	8.4		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	4%	4%
69c	NCT	76.2	NCT	76.2	NCT	73.2		2.3	2.3	2.2	3.0	3.0	2.9	3.0	3.0	2.9	4%	4%
70	GB	175.8	GB	175.8	GB	165.8		5.3	5.3	5.0	24.6	24.6	23.2	24.6	24.6	23.2	14%	14%
70a	Heli	79.9					0.2				1.8	0.0	0.0	2.0	0.2	0.2	3%	0%
71	GB	281.1	GB	281.1	GB	243.4		8.4	8.4	7.3	39.4	39.4	34.1	39.4	39.4	34.1	14%	14%
71a	NCT	402.7	NCT	402.7	NCT	368.2		12.1	12.1	11.0	16.1	16.1	14.7	16.1	16.1	14.7	4%	4%
72	GB	143.2	GB	143.2	GB	131.7		4.3	4.3	4.0	20.0	20.0	18.4	20.0	20.0	18.4	14%	14%
73	GB	59.4	GB	59.4	GB	59.4		1.8	1.8	1.8	8.3	8.3	8.3	8.3	8.3	8.3	14%	14%
74	GB	24.7	GB	24.7	GB	24.7		0.7	0.7	0.7	3.5	3.5	3.5	3.5	3.5	3.5	14%	14%
75	GB	43.9	GB	43.9	GB	43.9		1.3	1.3	1.3	6.1	6.1	6.1	6.1	6.1	6.1	14%	14%
76	GB	59.7	GB	59.7	GB	59.7		1.8	1.8	1.8	8.4	8.4	8.4	8.4	8.4	8.4	14%	14%
77	GB	21.4	GB	21.4	GB	21.4		0.6	0.6	0.6	3.0	3.0	3.0	3.0	3.0	3.0	14%	14%
78	Heli	10.4	Heli	10.4	Heli	8.6		0.3	0.3	0.3	0.5	0.5	0.4	0.5	0.5	0.4	5%	5%
79	Sky	64.8	Sky	64.8				1.9	1.9	0.0	5.2	5.2	0.0	5.2	5.2	0.0	8%	8%
80	Heli	27.4	Heli	27.4	Heli	27.4		0.8	0.8	0.8	1.4	1.4	1.4	1.4	1.4	1.4	5%	5%
81	GB	16.9						0.5	0.0	0.0	2.4	0.0	0.0	2.4	0.0	0.0	14%	0%
82	Sky	39.6						1.2	0.0	0.0	3.2	0.0	0.0	3.2	0.0	0.0	8%	0%
83	Sky	50.3	Sky	50.3				1.5	1.5	0.0	4.0	4.0	0.0	4.0	4.0	0.0	8%	8%
84	GB	71.2	GB	71.2	GB	69.9		2.1	2.1	2.1	10.0	10.0	9.8	10.0	10.0	9.8	14%	14%
85	Sky	13.1	Sky	13.1	Sky	7.3		0.4	0.4	0.2	1.0	1.0	0.6	1.0	1.0	0.6	8%	8%
86	Sky	81.6	Sky	81.6				2.4	2.4	0.0	6.5	6.5	0.0	6.5	6.5	0.0	8%	8%

Unit	Alt 2 Harvest System Proposed	Alt 2 Acres	Alt 3 Harvest System Proposed	Alt 3 Acres	Alt 4 Harvest System Proposed	Alt 4Acres	DSC Alt 1 Acres Observed	ALT 2 Est. DSC (Ac*3%)	ALT 3 Est. DSC (Ac*3%)	ALT 4 Est. DSC (Ac*3%)	Alt 2 Expected DSC[16]	Alt 3 Expected DSC[16]	Alt 4 Expected DSC[16]	Alt 2 Expect Cumulative DSC[17]	Alt 3 Expect Cumulative DSC[17]	Alt 4 Expect Cumulative DSC[17]	Alt 2 Cumulative DSC%	Alt 3 Cumulative DSC%
87	GB	21.3	GB	21.3	GB	21.3	0.0				2.3	2.3	2.3	2.3	2.3	2.3	11%	11%
88	GB	54.2	GB	54.2	GB	51.5		1.6	1.6	1.5	7.6	7.6	7.2	7.6	7.6	7.2	14%	14%
89	GB	55.8	GB	55.8	GB	54.5		1.7	1.7	1.6	7.8	7.8	7.6	7.8	7.8	7.6	14%	14%
90	GB	129.9	GB	129.9	GB	102.8	0.2				14.5	14.5	11.5	14.7	14.7	11.7	11%	11%
91	GB	78.9	GB	78.9	GB	78.9		2.4	2.4	2.4	11.0	11.0	11.0	11.0	11.0	11.0	14%	14%
92	GB	33.9	GB	33.9	GB	33.9		1.0	1.0	1.0	4.7	4.7	4.7	4.7	4.7	4.7	14%	14%
93	GB	62.4	GB	62.4	GB	51.3		1.9	1.9	1.5	8.7	8.7	7.2	8.7	8.7	7.2	14%	14%
94	GB	85.6	GB	85.6	GB	78.8		2.6	2.6	2.4	12.0	12.0	11.0	12.0	12.0	11.0	14%	14%
95	GB	6.8	GB	6.8				0.2	0.2	0.0	1.0	1.0	0.0	1.0	1.0	0.0	14%	14%
96	GB	42.0	GB	42.0	GB	40.6		1.3	1.3	1.2	5.9	5.9	5.7	5.9	5.9	5.7	14%	14%
97	GB	25.0	GB	25.0	GB	24.7		0.8	0.8	0.7	3.5	3.5	3.5	3.5	3.5	3.5	14%	14%
98	GB	25.2						0.8	0.0	0.0	3.5	0.0	0.0	3.5	0.0	0.0	14%	0%
99	GB	165.0	GB	165.0	GB	165.0		5.0	5.0	5.0	23.1	23.1	23.1	23.1	23.1	23.1	14%	14%
100	NCT	17.0		17.0		17.0		0.5	0.5	0.5	0.7	0.0	0.0	0.7	0.0	0.0	4%	0%
200	NCT	37.9	NCT	37.9	NCT	37.9		1.1	1.1	1.1	1.5	1.5	1.5	1.5	1.5	1.5	4%	4%
201	GB	128.7	GB	128.7	GB	128.7		3.9	3.9	3.9	18.0	18.0	18.0	18.0	18.0	18.0	14%	14%
202	GB	131.3	GB	131.3	GB	127.1		3.9	3.9	3.8	18.4	18.4	17.8	18.4	18.4	17.8	14%	14%
205	GB	97.6	GB	97.6	GB	95.8		2.9	2.9	2.9	13.7	13.7	13.4	13.7	13.7	13.4	14%	14%
205a	NCT	106.7	NCT	106.7	NCT	106.7		3.2	3.2	3.2	4.3	4.3	4.3	4.3	4.3	4.3	4%	4%
205b	GB	391.0	GB	391.0	GB	385.4		11.7	11.7	11.6	54.7	54.7	54.0	54.7	54.7	54.0	14%	14%
207	GB	318.9	GB	318.9	GB	276.8		9.6	9.6	8.3	44.6	44.6	38.8	44.6	44.6	38.8	14%	14%
208	GB	140.6	GB	140.6	GB	140.4		4.2	4.2	4.2	19.7	19.7	19.7	19.7	19.7	19.7	14%	14%
209	GB	24.6	GB	24.6	GB	24.6		0.7	0.7	0.7	3.4	3.4	3.4	3.4	3.4	3.4	14%	14%
210	GB	60.4	GB	60.4	GB	60.2		1.8	1.8	1.8	8.5	8.5	8.4	8.5	8.5	8.4	14%	14%
212	GB	161.3	GB	161.3	GB	147.9		4.8	4.8	4.4	22.6	22.6	20.7	22.6	22.6	20.7	14%	14%
CG-1	GB	12.2	GB	12.2	GB	12.2		0.4	0.4	0.4	1.7	1.7	1.7	1.7	1.7	1.7	14%	14%
LO-1	GB	17.5	GB	17.5	GB	17.5		0.5	0.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5	14%	14%
LO-2	GB	3.0	GB	3.0	GB	3.0		0.1	0.1	0.1	0.4	0.4	0.4	0.4	0.4	0.4	14%	14%
LO-3	GB	18.2	GB	18.2	GB	18.2		0.5	0.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5	14%	14%
		12219.5		11540.4		10477.7	6.9	325.4	305.9	275.8	1496.7	1399.8	1298.8	1503.6	1406.7	1305.7	12%	12%

Appendix L
Forest Vegetation Report

Kahler Dry Forest Restoration Project

Forest Vegetation Report

Prepared by:

Megan H Smith

South Zone Silviculturist

Heppner Ranger District

Umatilla National Forest

July 17, 2015

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Introduction

Forests of the Blue Mountains, including the Kahler planning area, are ecologically diverse, stemming from complex ecological interactions between forest tree species and climate, geology, soils. Disturbance patterns such as logging, insects, disease, fire, and extreme weather events also influence the forests. Conifer trees such as ponderosa pine, Douglas-fir, western juniper; and associated shrub and herbaceous plant species dominate and define the forest communities within Kahler Creek and surrounding areas. This vegetation analysis addresses the need for treatments identified in the purpose and need:

- Restore and promote open stands of old forest dominated by ponderosa pine, thereby moving the area toward its historical range in structure, density, and species composition.
- Maintain and promote old trees (>150 years old) throughout the project area.
- Provide a supply of commercial forest products to support and maintain local infrastructure.
- Reduce insect and disease risk, where currently outside the historical range, to dry upland forest stands and associated wildlife.
- Reestablish the character of a frequent fire regime to the landscape to aid in maintaining open stand conditions and fire-tolerant species, improve big game forage, and reduce conifer encroachment.
- Reduce encroachment of western juniper and conifers into areas where they did not historically occur to improve big game forage, the quality of grassland and steppe-shrubland habitat for wildlife, the diversity and productivity of riparian plant communities, and water availability for native vegetation.
- Provide, develop, and enhance effective and well-distributed habitats throughout the Forest for all existing native and desired nonnative vertebrate wildlife species, particularly those associated with late and old structural stages in dry upland forest stands (e.g. white-headed and Lewis' woodpecker).
- Provide for a high level of potential habitat effectiveness at the landscape scale to meet the needs of big game in the winter range management area.
- Address issues in big game habitat including the existing extent and distribution of cover, the quantity and quality of forage, and disturbance associated with roads and trails open to full-sized vehicles and OHVs.
- Reduce the risk of loss from wildfire by improve fire sighting capabilities from Tamarack Lookout.

Resource Indicators and Measures

Resource indicators are used to examine how management actions would possibly address the purpose and need, and to aid in analyzing potential environmental affects to vegetation. These indicators and units of measure for each are: forest structure, species composition, and stand density (Table 2).

Species Composition: Stand level changes trending toward long-lived early seral species such as western larch and ponderosa pine as measured by the percent of acres treated. Species composition is evaluated by forest cover types, which are named for tree species with the greatest percentage of stocking in a stand.

Stand Density: stand level changes in the amount of tree vegetation on a unit of land as measured by percent of acres treated. It can be described as basal area (BA), stand density index (SDI) (Reineke 1933), or other parameters. For the Kahler planning area the density classes of high, moderate, and low are based on stand density index with low having a SDI below 80, moderate having a SDI between 81 and 121, and high having a SDI greater than 121.

Table 1: Resource indicators and measures for assessing effects (environmental consequences)

Resource Element	Resource Indicator	Measure	Addresses Purpose & Need?	Source
Species composition	Forest cover types	acres treated	Yes	Martin 2010 letter
Stand density	Density classes	acres treated	Yes	Martin 2010 letter
Stand structure	Structural stages	acres treated	Yes	Martin 2010 letter

Forest Structure: Stand level changes in forest structure as reflected in the horizontal and vertical distribution and relative size of stand components as measured by the percent of acres treated to meet these specific objectives, expressed as relative terms. Oliver and Larson (1996) categorize forest structures into four categories: stand initiation, stem exclusion, understory reinitiation, and old-growth. Similarly Losensky (1994) categorizes forest structure into stand initiation, stem exclusion-open canopy, stem exclusion-closed canopy, understory reinitiation, young forest-multi strata, old forest-multi strata, and old forest-single strata. Structure stages for the Umatilla National Forest Range of Variation direction includes five structural stages (Martin, 2010): stand initiation (SI), stem exclusion (SE), understory reinitiation (UR), old forest single stratum (OFSS), and old forest multi-strata (OFMS). Table 2 shows correlations between Martin 2010, Oliver and Larson, and Losensky.

Table 2: Correlations between Umatilla NF, Oliver and Larson, and Losensky as they relate to structure

Umatilla NF Range of Variation Structure Stages	Oliver and Larson Structure Stage	Losensky's Structure Stage	Losensky's Age Structure
Stand Initiation	Stand Initiation	Stand Initiation	Seedling/Sapling (0-40 yrs)
Stem Exclusion	*Stem Exclusion*	*Stem Exclusion-Open Canopy*	*Pole (generally 41-100 yrs)*
		Stem Exclusion-Closed Canopy	
Understory Reinitiation	Understory Reinitiation	Understory Re-initiation	Mature (generally 101-150 yrs, with second cohort of younger trees)
		Young Forest Re-initiation	
Old Forest Multi-Strata	*Old Growth*	*Old Forest Multi-Strata*	*Over-mature (150+ yrs)*
Old Forest- Single Strata		*Old Forest- Single Strata*	

Methodology

Stand exam information collected in 2010 and 2011, along with the Most Similar Neighbor (MSN) imputation process (Crookston et al. 2002, Moeur and Stage 1995) were utilized to generate information on forest vegetation attributes such as forest cover type, stand density, potential vegetation types, and potential vegetation groups. MSN algorithms use canonical correlation analysis to derive a similarity function, and then chooses the most similar stand as a proxy from the global set of stands by comparing detailed design attributes (local variables) and lower-resolution indicator attributes (global variables). The most similar stand is selected by using the similarity function to maintain multivariate relationships between the global variables and the local variables. Scientific literature, field reviews, and subsequent silvicultural assessments were used in the analysis to identify site specific treatment needs that address the purpose and need for the project.

The inherent limitations to the database and models are recognized. Regardless, the data represents the most comprehensive data available for the planning area. The data is used for broad generalizations, arithmetic sums and means, and to supplement current, site-specific information gathered at each proposed unit and area of interest.

The Kahler forest vegetation analyses utilize a variety of information sources. Some vegetation characterizations were derived by using complex processes such as MSN imputation procedures. For this reason, the methodologies, modeling, and procedures employed during creation of forest vegetation databases are described in a separate specialist report (Justice, 2014).

This effects analysis relies in part on *Range of Variation Recommendations for Dry, Moist, and Cold Forests* (Powell, 2014b) and *Potential Vegetation Hierarchy for the Blue Mountains Section of Northeastern Oregon, Southwestern Washington, and West-Central Idaho* (Powell et al. 2007) to discuss concepts and principles, and ecosystem variation of potential vegetation groups (PVGs) found in the planning area. Potential Vegetation Groups are named for the predominant temperature and moisture influence, which plant association groups are grouped into. Dry Upland Forest is the prominent PVG found within the Kahler planning area at 87 percent (table 3). Table 3 lists the more common potential vegetation types found in the Kahler planning area.

Table 3: Potential vegetation composition of the Kahler planning area

Potential Vegetation Group	Area (Acres)	Percent
Dry Upland Forest	28,600	87%
Moist Upland Forest	380	1%
Nonforest (No PVG assigned)	3,840	12%
Total	***32,840***	***100%***

Table 4: Most common potential vegetation types (PVT) found in the Kahler planning area.

PVG	Ecoclass	PVT Code	PVT Common Name	Acres
Dry Upland Forest	CDG111	PSME/CAGE2	Douglas-fir/elk sedge	4,460
	CDG112	PSME/CARU	Douglas-fir/pinegrass	8,130
	CDS624	PSME/SYAL	Douglas-fir/common snowberry	4,950
	CDS625	PSME/SYOR2	Douglas-fir/mountain snowberry	690
	CWG111	ABGR/CAGE2	Grand fir/elk sedge	2,990
	CWG113	ABGR/CARU	Grand fir/pinegrass	1,310
	CPG222	PIPO/CAGE2	Ponderosa pine/elk sedge	1,090
	CPS226	PIPO/PUTR2/FEID-AGSP	Ponderosa pine/bitterbrush/Idaho fescue-bluebunch wheatgrass	1,980

Proposed treatments were then identified by a silvicultural forester based on observed existing vegetation conditions; desired stand conditions based on interdisciplinary evaluation; and potential contribution to the larger landscape. Desired stand conditions and potential treatments to obtain them are ecologically compatible with the site, and the current and historic disturbance patterns and successional pathways of the landscape's vegetation. These desired stand conditions are based on the Umatilla Forest Plan management area direction, and site-specific objectives recommended by the Interdisciplinary Team. Recommendations from site visits by Region 6 Forest Health Protection specialists, Forest Silviculturist, and Forest Leadership Team were incorporated into the proposed treatments.

Incomplete and Unavailable Information

I am not aware of any incomplete or unavailable information that would have influenced the Kahler forest vegetation analyses.

Reference Conditions

Reference conditions refer to past or historic conditions or an ecosystem. Historic Range of Variability (HRV) is a term found in literature used to describe historic (reference) conditions. The purpose of describing reference conditions is to explain how human and natural disturbance have changed forest conditions. This information provides insights to important questions such as natural frequency, intensity, and scale of disturbances, abundance, and rareness of plant and animal species, and the age class and composition of trees (Kaufmann et al, 1994). Fire, insects, and disease are important disturbance processes, creating a dynamic mosaic of forest conditions. These natural events can occur in small, localized areas or impose changes over broad landscapes. Species composition, habitat diversity, age class distribution, and stand structure are direct results of disturbances.

As stated by Morgan et al (1994), "*The utility of historical circumstances as reference conditions are in describing the dynamics of ecosystems undergoing continual change.... The status of an ecosystem variable...may have varied dramatically over time, but it did so at characteristic rates that reflect important ecosystem processes.... The rate of change affects the ability of species to adapt to new conditions.... Thus, the rate of change is likely to have as great an influence on biodiversity as the ecosystem conditions themselves.*" We are not attempting to precisely recreate past conditions, and do acknowledge that the modern human imprint cannot be eliminated. While mimicking historic conditions is not the answer or necessarily the desired condition, it does provide a reference, which combined with an assessment of future environment can help managers determine management activities that are ecologically sound and that will trend the landscape toward sustainable desired conditions.

Proposed management activities are designed to fit within acceptable and manageable historic ranges (reference conditions) identified, and is designed to foster the processes and patterns that make up the ecosystem. It is hypothesized where forest composition and structure occur within a historic range of conditions, the function of the landscape community will also be maintained within its historic range. It is important to note that function cannot be maintained by restoring the vegetative structure, composition and stand density without restoring fire on the landscape. No mechanical means alone can duplicate the unique ecological effects of wild land fire, such as soil heating, nutrient recycling, and the resulting effects to the community composition and structure (Kauffman 2004, Page 880).

Fire Ecology and Forest Succession

Fire has been a major influence on vegetative patterns, composition, structure, function, age and development of both individual stands and the larger landscape. The intensity and frequency of historic fires and the resulting patch size and vegetative succession are predictable based on the biological, physical, and climatic factors of the landscape. Forest vegetation adapted to these disturbance processes. For example, fire adapted species like western larch, Douglas-fir, and ponderosa pine have evolved thicker bark and deep root systems that withstand frequent fires of higher intensity more effectively than species with thin bark and shallow roots such as lodgepole pine and true firs.

Prior to European settlement of the western states, the landscapes of eastern Oregon were largely characterized by the natural fire regime; influenced by varying moisture, temperature, and vegetative composition. Fires generally burned in the understory, perpetuating the open park like stands with grassy undergrowth (Mutch et al, 1993). Persistent, large diameter western larch, Douglas-fir, and ponderosa pine helped to maintain a mix of species. Historical fire regimes in the planning area are evident based on fire scars on older ponderosa pine trees. Fire and subsequent fire suppression has important influences on vegetation conditions in the planning area.

Human Influence

Humans have occupied the Blue Mountains and high lava plains for at least 12,000 years (McNab et al, 1994). People would gather seasonally at camps on rivers, streams, or large upland meadows to exploit concentrated resources and utilize stored resources. They often burned grasses and understory to improve berry production, big game forage, and to drive game. In the mid 1800's Euro-American settlement began, with increased exploitations with the discovery of gold in the 1860's. Mineral extraction and associated transportation improvements led to increased Euro-American settlement. Logging, logging railroad construction, cattle and sheep grazing followed.

After the big burn of 1910, a national fire policy was initiated by the U.S. Forest Service, which has played a significant role in alteration of the environment. No longer are the fire adapted landscapes found in the Kahler Planning area influenced by their natural fire frequent fire return intervals.

Insects and Disease

Most insects and diseases (pathogens) have integral functions in the forest ecosystem. Tree diseases and insect infestations support first-tier food web sources, such as insects for predator populations. These components indirectly support cavity nesters by playing a decomposition role in nutrient recycling and providing snags. They play a role in the fire ecology by creating areas of dead conifers that combined with other factors can fuel fires from large stand-replacing fires or mixed severity localized fires.

Historically, the most conspicuous insects and diseases in the forest were bark beetles, Douglas-fir tussock moth, and western spruce budworm. Impacts from mining and logging in late 1800s to early 1900s removed ponderosa pine and western larch from the landscape. Replacement stands were more shade tolerant species like true firs and Douglas-fir (Wickman, 1992). These more shade tolerant stands, selective harvest, and fire suppression have reduced the opportunity for early seral species to establish in some areas. Douglas-fir Tussock moth and western spruce budworm has increased tree mortality, top kill, and growth loss; culminating in decreased timber productivity and increased fire hazard.

Affected Environment

The proposed project area is located in the Alder Creek, Lower Kahler Creek, Upper Kahler Creek, Haystack Creek, and Bologna Canyon sub-watersheds; and lies within Grant and Wheeler counties. The planning (analysis) area contains approximately 32,840 acres. Of these acres, approximately 26,980 acres are considered dry forest and designated as suitable lands under the Forest Plan. It is these 26,980 acres that are considered under the affected environment (table 5). Figure 1 presents a map of the forest vegetation affected environment.

Table 5: Acreage summary for the Kahler forest vegetation affected environment

Approximate acreage of National Forest System (NFS) lands in the Kahler planning area	32,840
Total NFS lands designated as suitable for timber production	31,090
Total NFS lands designated as dry forest in affected environment	***26,980***
Affected environment modified in alternative 1	0
Affected environment modified in alternative 2	12,220
Affected environment modified in alternative 3	11,540
Affected environment modified in alternative 4	10,480

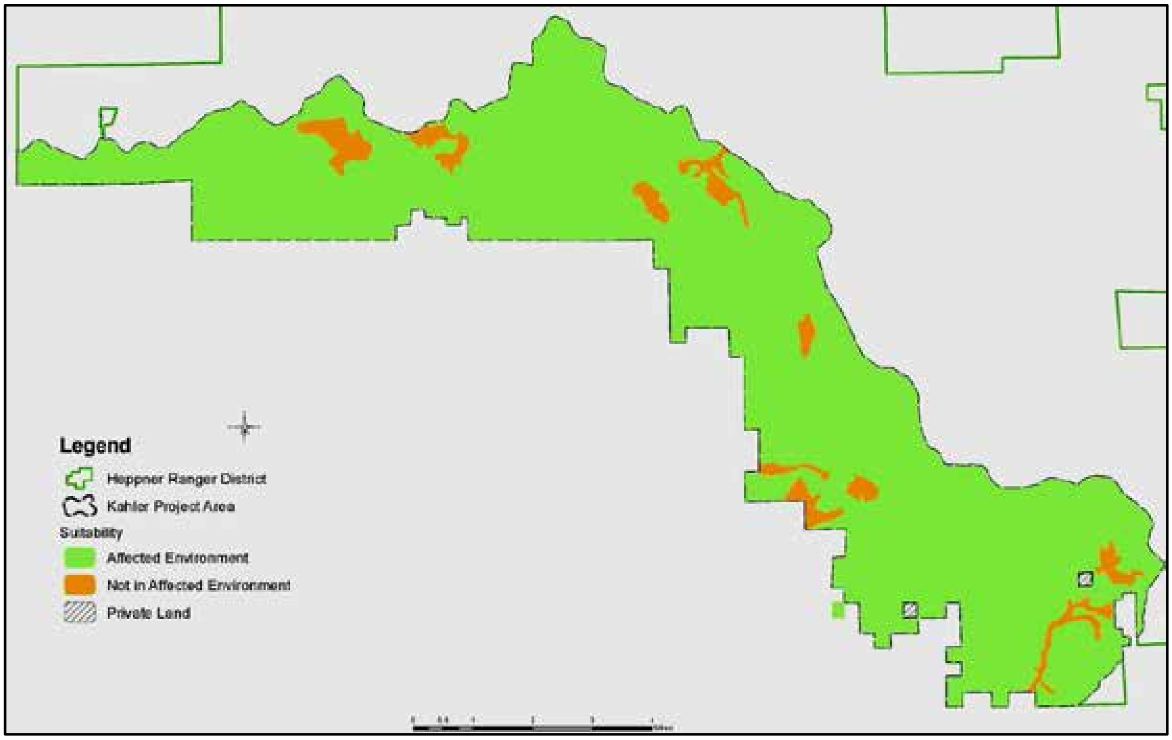

Figure 1: Affected environment for forest vegetation analyses.

Species Composition, Stand Density, and Forest Structure

Species composition refers to the predominant cover type, or that plant species forming the plurality of the composition across a given area. General Land Office (GLO) survey notes taken between 1879 and 1887 describe the Kahler area as ponderosa pine woodland or savanna (66% of the area), followed by mixed-conifer forest (likely including ponderosa pine, Douglas-fir, and grand fir) (20% for the two mixed-conifer types combined), nonforest grassland and shrublands (10%), and five other miscellaneous vegetation types occurring at relatively low levels (2% of the planning area or less individually). A Umatilla National Forest white paper describes how the GLO survey notes were interpreted, and then converted into a geospatial data source (Powell, 2013).

Stand density is the amount of tree vegetation on a unit of land as measured by percent of acres treated. Local, site-specific stocking guidelines (Cochran et al. 1994, Powell 1999) are used to infer whether stands are stocked with trees at a low, moderate, or high level. Forests with high density levels generally occur in a self-thinning zone where trees aggressively compete with each other for moisture, sunlight, and nutrients. Forests in the self-thinning zone eventually experience mortality as crowded trees die from competition, or killed by insects or diseases (Cochran et al. 1994, Powell, 1999).

Forest structure, or stand structure, can be defined as “the physical and temporal distribution of plants in a stand” (Helms, 1998). Structure changes as forests age, move across successional stages, and endure disturbance. Change is fundamental to all ecosystems, and disturbances are inevitable. Change is the only constant in our ecosystems. Vegetation community patterns reflect the combined influence of these disturbances along with the effects of settlement, timber management and fire suppression. Resulting plant communities vary considerably with site characteristics such as: topography; solar radiation; precipitation; elevation and soils, and plant species distribution and development patterns. Natural processes, such as fire, insect and disease activity, and succession will continue to change the plant communities. On a local scale, management activities can affect the course of these changes, to some degree, and support the integrity of the ecosystem while providing for human needs.

Historic Range of Variability

The overall climatic condition on the Umatilla National Forest has remained relatively uniform for approximately the past 2,000 years. Within this period, disturbance processes together with landform and other environmental elements formed the major factors influencing the patterns of vegetation types across the landscape. Species abundance, distribution, and viability resulted from this dynamic pattern. Native plants and animals throughout this period and prior to changes brought about by modern day settlement and management, adapted to the rate of these climatic and disturbance regimes.

The HRV is the context in which current and future conditions can be evaluated. For example, the condition and treatments of vegetation can affect the following:

- Departure from species composition
- Departure from stand density
- Departure from forest structure

Departures from HRV may result in changes to one or more ecological components including vegetation characteristics, fuel composition, fire frequency, severity and pattern and other associated disturbances such as insect and disease, grazing, harvesting, etc.

As HRV analysis is greatly influenced by scale, Powell recommends that HRV analysis be completed for land areas no smaller than 15,000 to 35,000 acres (Powell 2014b), therefore the cold upland forest and the moist upland forest PVGs were dropped from further analysis. HRV evaluations for the Kahler planning area were completed for approximately 31,120 acres of forest vegetation, which includes approximately 3,840 acres of nonforest grassland and shrubland. An upland-forest PVG comprising less than 1,000 acres in an HRV planning area should be dropped from further consideration because such a small area would not be expected to produce a full range of composition, structure, and density conditions (Powell 2014b).

Existing Conditions

Existing vegetative patterns are influenced by largely by the Cascade Mountains, approximately 200 miles to the west. Labeled as Temperate Continental, the mean temperature in the Blue Mountains is 72 degrees F with average annual precipitation between 17 and 100 inches. At higher elevations, most of the precipitation falls as snow. Low relative humidity, abundant sunshine, and wide fluctuations in both temperature and precipitation are characteristics that influence the existing conditions. It is the temperate continental climate that promotes the ponderosa pine, western juniper, and sagebrush commonly found in the southern Blue Mountains.

Cumulative influences of natural and human-caused disturbances define the species composition, forest structure and function of the landscape. Wildfire historically played a role interrupting forest succession and creating much of the existing vegetative diversity.

Species Composition

Overall, the affected environment has developed a relatively homogenous cover of two-aged to multi-aged stands dominated (64 percent) by ponderosa pine. Douglas-fir provides approximately 29 percent of the cover by species. The two remaining species that provide a measurement of cover are grand fir at five percent and western juniper at three percent (table 6). Incidental species found in the affected environment are Quaking aspen, Engelmann spruce, lodgepole pine, and western larch.

In addition to conifer trees, understory vegetation of various shrubs, forbs, and grasses are present. Understory vegetation for dry upland forests includes shrubs such as: common snowberry, creeping Oregon-grape, heartleaf arnica, baldhip rose, serviceberry, and spirea. Forbes include: heartleaf arnica, woods strawberry, yarrow, and meadowrue. Grasses such as pinegrass, elk sedge, bluebunch wheatgrass, Idaho fescue and western fescue are also present throughout the planning area.

Aspen stands within the Kahler planning area are quite small (the largest stand occupies app. 9 acres, and many stands are 1 acre or less in size) and typically occur as inclusions within larger stands. Since aspen provides important ecosystem services related to its value as wildlife habitat and for vegetation biodiversity, it is carefully monitored during vegetation analysis, even though it seldom occurs in stands large enough to classify as a separate cover type.

Departure from Reference Conditions: Forest Cover Types

Note that reference conditions refer to past or historic conditions of an ecosystem. Spatial data derived from GLO survey notes were used for analysis. Since the 1880s, factors of most influence have become timber harvest, insect and disease outbreaks, and fire suppression. The effects of these human and natural influences are evident given the increase in Douglas-fir, which currently exceeds HRV (table 6). Historically, low to mixed severity fires occurring every 5 to 20 years favored ponderosa pine and western larch allowing them to persist and regenerate. Douglas-fir, on the other hand, can regenerate on a variety of seedbeds independent of mineral soil or disturbance. If ponderosa pine and western larch fail to reproduce or is limited, Douglas-fir will dominate the overstory throughout stand development. Although ponderosa pine is within HRV, western larch is under (or outside) its historical range.

Table 6: Comparison of Existing conditions to HRV for forest cover types of the Kahler forest vegetation affected environment. Grey shaded cells are outside historical range.

Forest Cover Type	*Dry Upland Forest*			
	Historical Range		Existing Conditions, 2012	
	Acres	Percent	Acres	Percent
Douglas-fir	1,350-5,400	5-20%	7,760	29%
Grand fir	270-2,700	1-10%	1270	5%
Ponderosa pine	13,500-21,600	50-80%	17,200	64%
Subalpine fir and spruce	0	0%	0	0%
Western juniper	0-1,350	0-5%	750	3%
Western larch	270-2,700	1-10%	0	0%
Western white pine	0-1,350	0-5%	0	0%
Total			***26,980***	***100%***

Stand Density

Currently, the predominant stand density class is high, with 45 percent of the affected environment having a stand density index greater than 121 (table 7). As stated earlier, a high index indicates the stands are in a self-thinning zone where trees aggressively compete with each other for moisture, sunlight, and nutrients. The low stand density class follows with 38 percent of the affected environment having a stand density index lower than 81. Stands with low density have less than full site occupancy, maximum individual tree growth, and minimum whole stand volume growth. The moderate class has a stand density index between 81 and 121. Intermediate individual tree diameter growth and intermediate whole stand volume growth are realized in stands with a moderate density.

Departure from Reference Conditions: Stand Density

As with species composition, spatial data derived from GLO survey notes were used for analysis. Timber harvest, insect and disease outbreaks, and fire suppression have been the most influential factors since the 1880s. Historically, low to mixed severity fires burning, on a in the understory, perpetuating the open park like stands with grassy undergrowth. These more frequent fires (5 to 20 years) promoted and maintained open park-like stands. Human and natural influences are evident with the increase in high density stands which currently exceed HRV (table 7). More shade tolerant species such as Douglas-fir and grand fir have since established themselves in higher densities than what occurred historically. Although not species specific in this analysis, table 7 shows the high density stands have more than doubled since the 1880s and is well outside HRV.

Table 7: Comparison of Existing Conditions to HRV Stand Density of the Kahler forest vegetation affected environment. Grey shaded cells are outside historical range.

Stand Density Class			Historical Range		Existing Conditions, 2012	
Class	SDI	Basal Area (BA)	Acres	Percent	Acres	Percent
Low	0-80	0-44 sq ft/ac	10,800-22,950	40-85%	10,190	38%
Moderate	81-121	45-70 sq ft/ac	4,050-8,100	15-30%	4,520	17%
High	122+	71+ sq ft/ac	1,350-4,050	5-15%	12,270	45%
Total					***26,980***	***100%***

Forest Structure

Forest structural stage is used as an indicator for the forest structure measure. Existing structures range from 33 percent stem exclusion (SE) to 5 percent old forest single stratum (OFSS), see Table 8. Understory reinitiation (at 32 percent) and stem exclusion are the most dominant structure stages found in the Kahler affected environment. Approximately 20 percent is in the stand initiation (SI) phase. Old forest is the least represented at 9 percent multi-strata (OFMS) and 5 percent single stratum (OFSS). Existing age classes range from seedling/sapling to over mature sawtimber, but dominated by mature sawtimber stands. Stands exhibit a range of stand ages, a reflection of its natural and human-influenced disturbance history. The variation in structural attributes relates to the mosaic of natural disturbance, past harvest, and the resulting habitat characteristics. The spatial distribution of forest structural stages is presented in figure 2.

Table 8: Comparison of Forest Structure Existing Conditions and HRV of the Kahler forest vegetation affected environment. Grey shaded cells are outside historical range.

Forest Structural Stage	Historical Range		*Existing Conditions, 2012*	
	Acres	Percent	*Acres*	*Percent*
SI: Stand Initiation	4,050-6,750	15-25%	***5,370***	***20%***
SE: Stem Exclusion	2,700-5,400	10-20%	***9,000***	***33%***
UR: Understory Reinitiation	1,350-2,700	5-10%	***8,760***	***32%***
OFSS: Old Forest Single Stratum	10,800-16,200	40-60%	***1,450***	***5%***
OFMS: Old Forest Multi-Strata	1,350-4,050	5-15%	***2,400***	***9%***
Total			***26,980***	***100%***

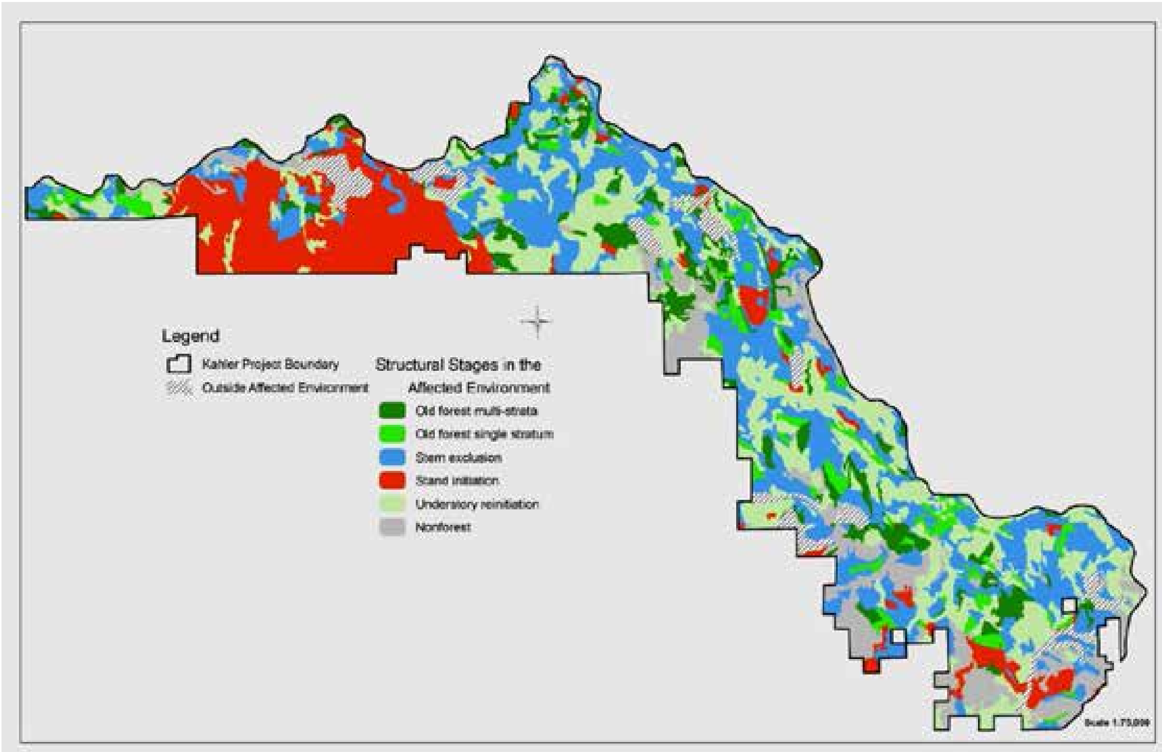

Figure 2: Existing condition (2012) for forest structural stages in the Kahler forest vegetation affected environment.

Departure from Reference Conditions: Forest Structure

Again, spatial data derived from GLO survey notes were used for analysis. Timber harvest, insect and disease outbreaks, and fire suppression have been the most influential factors since the 1880s. Historically, frequent low to mixed severity fires burning every 5 to 20 years promoted and maintained open park-like stands of early seral species, namely ponderosa pine. These fires tended to favor large trees with the thickest bark, producing an even aged appearance, but stands exhibited patchy age class distribution owing to the continuous regeneration of trees by fire (Harrod, et al, 1999). Human and natural influences, namely timber harvest and fire suppression are evident given the changes outside HRV in three of the five structure stages (table 8). Stem exclusion (SE) and understory reinitiation (UR) both exceed HRV, and old forest single stratum (OFSS) is well below HRV.

Human Influences

In the absence of frequent low to mixed severity fires, the once open stands of ponderosa pine mixed with Douglas-fir have developed a dense understory of Douglas-fir and grand fir (Hessburg et al, 2005). These longer fire intervals allow an increase in stand biomass, ladder fuels, and down wood fuel loadings to increase beyond what the sites likely experienced historically. In addition, the denser stands found in the Kahler planning area today are more susceptible to insect and disease problems such as bark beetles, Douglas-fir tussock moth, and western spruce budworm.

The greatest change in the planning area has been fire exclusion; logging (both selective and salvage harvests); insect and disease outbreaks; and the Wheeler Point Fire. Absence of nonlethal low severity fires across the drier sites have altered insect and disease regimes due to increased stand density and species composition favoring more shade tolerant and less disease resistant species such as Douglas-fir and grand fir. These maturing stands with a higher component of Douglas-fir and grand fir are more at risk to insects and disease. Also susceptible to increased insect and disease activity are aging ponderosa pine in the high density stands.

Timber harvest has been a disturbance agent throughout eastern Oregon for many decades (Oliver et al. 1994). Although major harvest activities did not begin until the 1940s, the effects of timber harvest throughout the Kahler planning area are still evident today. District timber harvest records indicate past harvest in the Kahler planning area between 1940 and 2009 totaling app. 25,900 acres (figure 3). Approximately 22,070 acres were harvested by single tree selection cuts or partial removals, generally large-diameter ponderosa pines and Douglas-firs were removed.

The remaining harvest acres used a variety of cutting methods, including clearcutting (app. 430 acres), shelterwood (app. 190 acres), overstory removal (app. 1,260 acres), seed-tree (app. 200 acres), and commercial thinning (app. 740 acres). In addition, areas with no recorded timber harvest often show evidence of previous partial-removal timber harvest, with stumps and skid trails scattered throughout them.

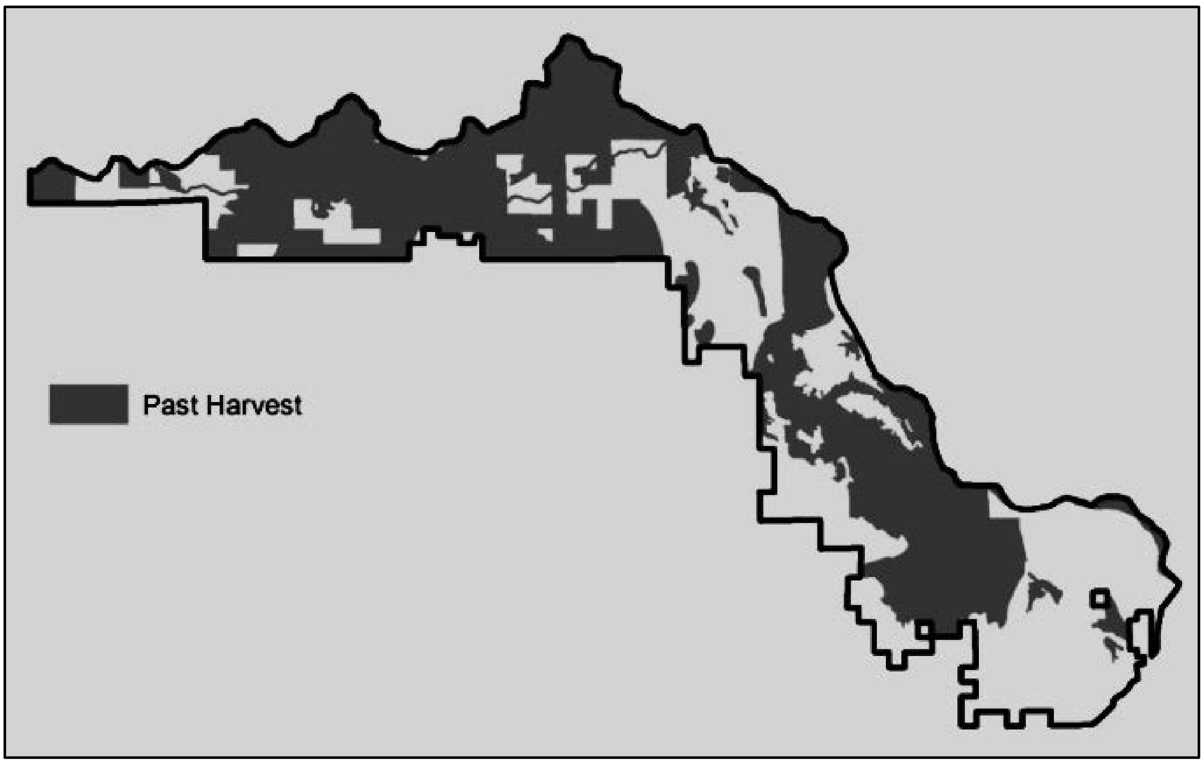

Figure 3: Historical timber harvest in the Kahler planning area.

Fire Ecology and Forest Succession

The Wheeler Point fire ignited on August 10, 1996 and grew rapidly to approximately 22,670 acres in size. Approximately 6,420 acres occur in the Kahler planning area. Stand replacing effects from the fire are now and foreseeably a management concern. Overstory trees, mostly ponderosa pine, suffered almost total mortality. Note that a strip of trees apparently survived (green and scorched crown is present) in the middleground portion of the photo (figure 4); post-fire monitoring across a multi-year timespan showed that few of these trees actually survived, so they were not available to serve as a seed source and contribute to natural tree regeneration of the fire area.

Figure 4: Aftermath of the 1996 Wheeler Point fire, located within the Kahler planning area (photo acquired by D.C. Powell in fall of 1996 or spring of 1997).

Insects and Disease

Major insects and diseases found within the planning area affecting species composition, stand density, and forest structure are described below. Many of these agents affect species composition, but are considered within the "normal" or "endemic range" of a natural process. A consideration of forest health emphasizes prevention as opposed to suppression as a management strategy for insects, pathogens and natural disturbances that are considered detrimental to resource production. This emphasis is made with recognition of their beneficial role with regard to resources and ecosystem functions.

Forest insect and disease activity has been monitored via aerial observations for many years in Region 6. The 2012 flight revealed mountain pine beetle affecting the ponderosa pine, as well as western pine beetle. Also worth noting is western spruce budworm affecting Douglas-fir, and mistletoe affecting several conifer species. Observations over past years reveal the ebb and flow of Douglas-fir tussock moth, western spruce budworm, mountain pine beetles, and western pine beetles in the Kahler planning area. We see that current stand attributes are setting the stage for future outbreaks given favorable weather and conditions. One example would be the more dense stands of ponderosa pine with Douglas-fir and grand fir. These dense conditions are favorable hosts to western spruce budworm, Douglas-fir tussock moth and pine beetles. Stands have a high number of trees per acre due to crowded conditions, which increases stress on each tree. The age and size of the ponderosa pine combined with high-stress conditions are ideal for an outbreak of western pine beetle, one organism that is found endemically on the Kahler landscape.

Mountain Pine Beetle (*Dendroctonus ponderosae*) is a bark beetle that generally attacks mature and over mature stands of lodgepole pine and other pine species. Outbreaks usually develop where average tree diameters are greater than 10", average stand age is 80 years or more, and in stands with high density. The relationship between ponderosa pine and mountain pine beetle is fairly well understood. Endemic populations of mountain pine beetle allow for natural thinning of pine stands, often attacking ponderosa pine in groups or clusters (Olsen et al, 1996).

Mountain pine beetle continues to increase in ponderosa pine stands of the planning area. A site visit by a regional pathologist confirmed that “both western and mountain pine beetle have been active in the area and increasing within the past two years” (USDA, 2010). This is expected as populations are increasing in the Blue Mountains.

Western Pine Beetle (*Dendroctonus brevicomis*) is a bark beetle that generally attacks ponderosa over 6 inches in diameter and of any vigor. Outbreaks usually develop in clumps of dense, overstocked stands. As with mountain pine beetle, the relationship between ponderosa pine and western pine beetle is fairly well understood. Endemic populations of mountain pine beetle allow for natural thinning of pine stands. It has been found that trees in poor health are at highest risk to attack by western pine beetle (Furniss, 1977).

Western pine beetle continues to increase in ponderosa pine stands of the planning area. A site visit by a regional pathologist confirmed that “both western and mountain pine beetle have been active in the area and increasing within the past two years” (USDA, 2010). This is expected as populations are increasing in the Blue Mountains.

Western Spruce Budworm (*Choristoneura occidentalis*) is a defoliator that prefers true fir, Douglas-fir, spruce and larch foliage. The larvae mine the buds and old needles in the spring, and then consume new needles as they emerge. After several years of heavy defoliation, branch dieback, top kill and tree mortality can occur. Mortality is rare for overstory trees as the larvae’s defense against predators (birds) is to drop out of the upper canopy via a silk thread to the lower canopy or understory trees. If tree mortality occurs, it is more common in these understory trees. Western spruce budworm caused widespread tree damage and mortality in both Douglas-fir and grand fir in the 1980s and 90s. Stand conditions that are conducive to the budworm are high density, multi-layered canopies of desired species – a common characteristic in this area. Discussions with regional entomologists indicate that outbreaks could relate to delayed effects of drought in the mid part of this decade, and that a return to normal moisture level may likely help the budworm population to subside.

Dwarf mistletoe (*Arceuthobium spp.*) is an endemic parasitic plant that depends on a host species for water, carbohydrates and minerals. Effects on the host tree are reduced height and diameter growth, weakened trees, decreased cone and seed production, top kill, and can lead to mortality. The typical lateral spread within the tree is 1-2 feet per year and seed spread is up to 100 feet from an infected tree. On-the-ground observations show that dwarf mistletoe is scattered and present, sometimes severe, in Douglas-fir and ponderosa pine (Schmitt and Spiegel, 2010). Though present in western larch throughout the area, it is not affecting every stand.

Environmental Consequences

This section will summarize the changes in species composition, stand density, and forest structural conditions that are likely to occur as the result of implementing the alternatives described in Chapter 2. The successional conditions predicted represent the most logical pathways given the existing stand conditions. Where the effects of the proposed treatments are very similar, disclosures are combined. These potential effects include direct, indirect, and cumulative effects, in full compliance with the National Environmental Policy Act (NEPA) and related law, regulation and policy. This section will display how each alternative addresses the purpose and need of the project and the major issues identified. The No Action alternative provides a baseline for comparison to the action alternatives. Cumulative effects are described and evaluated of the proposed action with other past, present and reasonably foreseeable actions.

The basis for this project is the stand-specific silvicultural diagnosis and the field review of the areas proposed for treatment. Existing stand conditions and proposed treatment options were site-specifically identified and reviewed. Additional information can be found in the stand summaries and stand diagnosis records in the project files.

The removal of vegetation during harvest and fuel treatments is considered under the action alternatives. These effects and the resulting change in vegetation will vary with the timing, size, number, and spatial arrangement of harvest units and associated road systems. These effects will be different from those expected to occur under a no action alternative.

The changes to vegetation from the proposed treatments have many direct and indirect effects on other resources. Specific resources affected would include wildlife, scenery, soils, water and fish, recreation, and fire. The detailed effects on these individual resources are disclosed in the respective sections in this chapter.

Alternative 1 – No Action

No activities would take place with this alternative. Only natural processes and fire suppression would occur, affecting the forest succession and health. Species composition and stand densities would continue to trend away from reference conditions. Condition of untreated stands would change over time, with continued mortality, and with declining growth and wood decay as a result of insect mortality. In many areas this change will continue a trend whereby shade-tolerant species, that are more prone to insects and disease and are less fire-adapted, replace shade-intolerant species that have adapted to the influences of fire and are generally less susceptible to insects and diseases. The no action alternative would not contribute to the purpose and need of; restore and promote ponderosa pine dominated stands of old forest; maintain and promote old trees; reduce insect and disease risk; reestablish frequent fire regime characteristics; reduce conifer encroachment in steppe-shrubland habitats; provide and enhance habitat effectiveness for big game and other wildlife species; and reduce risk of loss from wildfire. Also this alternative would not meet the purpose and need to provide a supply of commercial forest products to support and maintain local infrastructure.

Fire Ecology and Forest Health

With continued fire suppression and lack of prescribed fire, the understory trees would continue to develop, reaching into the general canopy as well as expand in scope. This, in addition to continued encroachment of fire intolerant species, would potentially increase fire severity. Prescribed fire would not be implemented and those units would likely remain without fire as a process to improve ecological integrity. As a result the quality and quantity of wildlife habitat would continue to decline in forage, browse, and hiding cover aspects.

The high density stands of ponderosa pine and Douglas-fir currently impacted by bark beetles would not be treated in this alternative and options to recover economic value and decrease stand density would be deferred. Often, these high density stands are infested with dwarf mistletoe. Without treatment these infested trees would remain onsite, perpetuating the disease and increasing the risk of crown fire. Western spruce budworm will likely remain as an endemic insect in the project area. Defoliation of understory trees would continue, with little mortality is expected in the overstory of most stands.

Species Composition and Stand Density

The descriptions of species composition and stand density outline stand development that would ordinarily follow natural disturbance processes including wildfire, insect and disease impacts, blowdown, etc. Assuming that traditional fire suppression would continue, species composition and stand densities described for the No Action Alternative would be inconsistent with ecological processes and may not create long-term, sustainable forest conditions.

Under the No Action alternative, both Douglas-fir and grand fir would continue to develop beyond historical levels as described previously under the departure from reference conditions section (table 6). Early-seral species (ponderosa pine and western larch) will continue to be replaced with late-seral Douglas-fir and grand fir because thinning and prescribed fire is not being used to periodically adjust composition. Since it is assumed that wildfire continues to be suppressed for the No Action alternative, then this keystone ecosystem process is also not available to function as a natural adjustment agent. Some shrub-steppe nonforest environments with high value to native ungulates would transition to a lower-value (for wildlife) western juniper woodland type.

With only natural processes and fire suppression occurring open stand conditions (low and moderate stand density classes) succeed into closed stand conditions. Under the no action alternative we can expect the low and moderate stand density classes to continue as substantially under-represented and high stand density to continue as substantially over-represented. Keystone ecosystem process referred to as short-interval surface fire is not available to function as a natural thinning agent under the no action alternative.

Forest Structure

As with species composition and stand density, successional pathways outlines stand development that would ordinarily follow natural disturbance processes that include wildfire, insect and disease impacts, blowdown, etc. The mosaic or patchy conditions that represent variation in species composition, forest type, and stocking levels are recognized. Assuming that traditional fire suppression would continue, the successional development described for the No Action Alternative would be inconsistent with ecological processes and may not create long-term, sustainable forest conditions. A comparison of current and referenced successional stage conditions (Table 8) shows structural stage distribution for dry forest in the affected environment.

The dry forest setting has historically experienced frequent, low intensity and mixed severity fires as a predominant natural disturbance. It is known that disturbance drives the development of forest structure; there are noticeable trends which can influence ecosystem health and landscape patterns. Without disturbance to promote or maintain the stand structure, representation of understory re-initiation (UR) will continue on its current increasing trajectory, as will stem exclusion (SE); and the transitions from early-seral structure to late-seral structure are expected to increase.

Under the no action alternative, we can expect late-seral, multi-cohort stand conditions (as represented by the old forest multi-strata (OFMS) and UR forest structural stages) to continue to replace the historically dominant early-seral, single-cohort (single-layer) forest structures (the old forest single stratum (OFSS), SE, and stand initiation (SI) stages). These trends would reduce maintenance of ponderosa pine, reduce forage potential for wildlife, and not trend stands towards a more open condition that better suits the reintroduction of fire as an ecosystem process. Since an assumption is that wildfire continues to be suppressed for the No Action alternative, then a keystone ecosystem process referred to as short-interval surface fire is not available to function as a natural thinning agent.

As these conditions border private lands, the importance of assessing the risks of no action alternative becomes all the more relevant. A no action alternative decision in these specific conditions would prevent the natural process of fire to be re-introduced onto the landscape and habitat diversity will not be enhanced, resulting in more continuous forest patches with less horizontal diversity.

Cumulative Effects

Past, present, proposed, and reasonably foreseeable activities were reviewed to determine cumulative effects to forest vegetation. Timber harvest, tree planting, noncommercial thinning, and other past actions helped create existing conditions in the planning area. Beginning in the 1940s, partial removal or regeneration harvest has occurred on approximately 28,500 acres. These managed stands have a mixed species composition and contribute to the vegetative diversity mosaic that occurs in the planning area. Since the

1970s, approximately 2,500 acres have been partially cut or thinned resulting in a variety of stand conditions ranging from open to patchy, giving trees sufficient room to grow. Stand composition generally consists of early and late seral species.

Effects of past management would not be altered under this alternative with forest conditions changing over time, prolonged fire return intervals in a frequent fire regime, continued mortality, and declining growth as a result of increased stand densities. For shade tolerant species, such as Douglas-fir and grand fir this condition would create available growing space, increased growth, and increased stand densities. In many areas this change would continue a trend whereby shade-tolerant species, that are more prone to insects and disease and are less fire-adapted, replace shade-intolerant species that have adapted to the influences of fire and are generally less susceptible to insects and diseases.

No action alternative foregoes the opportunity to restore and promote open stands of old forest dominated by ponderosa pine that is currently minimal on the landscape. Old forest (late-old) structure will continue to be marginal or deficient because proposed activities will not be used to reduce the stem exclusion and understory reinitiation structural stages, and thereby increase the future representation of old forest single stratum structural stage, which is substantially deficient at this time. Also, without active stand management, fire exclusion will likely result in an increase of pathogen and insect activity in the dry and transitional forests (Graham et al, 1994). Bark beetles would at first likely remain endemic, but later the effects of slash build up and increased competition and stress, as well as increasing age and diameters of species to become of higher risk would later increase beetle activities. Accumulation of fuels from existing and expected deadfall would likely increase the intensity of a fire in the future. Deferring the opportunity to thin previously harvested stands may, in the long term, compromise habitat diversity, tree health and vigor.

Alternatives 2, 3, and 4

Direct and Indirect Effects

Harvest Effects on Forest Health

The proposed alternatives would alter stand structure, alter species composition, and reduce stand densities primarily to promote dry forest conditions, improve growth, enhance forest health, and improve other resource objectives to varying degrees depending on treated acres. The effects to forest vegetation are generally the same for each alternative. Table 9 provides a comparison of treated acres of each proposed treatment.

Table 9: Treatment Summary by Alternative

ALTERNATIVE	**INTERMEDIATE TREATMENT***	*% of Project Area*	RX BURNING	*% of Project Area***
2	12,220	*35%*	31020	*94%*
3	11,540	*33%*	31020	*94%*
4	10,480	*30%*	31020	*94%*

*Note: **Intermediate Treatment** is any treatment or tending designed to enhance growth, quality, vigor, and composition of the stand after establishment or regeneration and prior to final harvest. For the Kahler project this includes: commercial thinning, shrub steppe enhancement, noncommercial thinning, riparian area thinning, and the Tamarack Fire Lookout. **Fifty to seventy percent of the area would actually be burned, per alternative descriptions.

The action alternatives would meet the project's purpose and needs of; restore and promote ponderosa pine dominated stands of old forest; and maintain and promote old trees; reduce insect and disease risk. Each alternative would meet these with a varying degree depending on acres treated.

Where forest conditions are outside the historic range of variability, concerns for ecosystem integrity and sustainability, species viability, and forest health are addressed by improving species and structural diversity in a variety of forest settings. Two-aged to uneven aged stands overstocked by mature ponderosa pine, Douglas-fir, and grand fir would be harvested to promote and maintain old forest structure, reduce stand densities, and reduce the incidence of shade tolerant species. Some natural regeneration would occur in more open stand conditions post treatment. These treatments would contribute to the overall goal of maintaining historic dry forest vegetative patterns through retention of larger, overstory trees, especially ponderosa pine and western larch. Forest health concerns would be addressed through proposed treatment of stands currently impacted by dwarf mistletoe, pine beetles, or western spruce budworm.

Alternative treatments, as designed, would not convert the current age class to another age class, but would accelerate development of more mature stand characteristics. Mature stands would remain as mature stands, considered on an accelerated trajectory toward old forest attributes. Intermediate treatment in old forest stands would maintain favorable characteristics while reducing densities. Treatments will help trend forest structural stages toward the distribution of historical range, refer to Table 8: Comparison of Forest Structure Existing Conditions and HRV of the Kahler forest vegetation affected environment.

Additionally, silvicultural treatments are expected to improve forest conditions that have resulted from the interruption of a natural fire cycle. Following harvest, activity fuels would be either mechanically treated or burned. These stands historically relied upon disturbance to maintain dry forest characteristics. Landscape burning through prescribed fire is recommended to maintain these characteristics. Following any proposed burning, browse would be rejuvenated and expand in coverage and nutritional value. Certainly, challenges and unplanned results are part of any project with complex objectives in a natural environment. Monitoring and adaptive management is an important part of restoring functioning ecosystems.

Harvest Effects on Species Composition and Stand Density

Table 10: Harvest Effects on Species Composition by Alternative for Dry Upland Forest. Areas in grey depict species outside of HRV. Grey shaded cells are outside historical range.

Forest Cover Type	Dry Upland Forest Potential Vegetation Group									
	Historical Range		Existing Conditions, 2012		ALT 2 Post-Treatment		ALT3 Post-Treatment		ALT 4 Post-Treatment	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Douglas-fir	1,350-5,400	5-20%	7,760	29%	4,310	16%	4,570	17%	5,100	19%
Grand fir	270-2,700	1-10%	1270	5%	790	3%	850	3%	900	3%
Ponderosa pine	13,500-21,600	50-80%	17,200	64%	21,370	79%	21,030	78%	20,460	76%
Subalpine fir and spruce	0	0%	0	0%	0	0%	0	0%	0	0%
Western juniper	0-1,350	0-5%	750	3%	510	2%	530	2%	520	2%
Western larch	270-2,700	1-10%	0	0%	0	0%	0	0%	0	0%
Western white pine	0-1,350	0-5%	0	0%	0	0%	0	0%	0	0%
Total			***26,980***	***100%***	***26,980***	***100%***	***26,980***	***100%***	***26,980***	***100%***

As a result of human influences, the affected environment has large areas of high density stands. Higher stocking density increases environmental stresses for trees; both diameter and height growth is decreasing, accompanied by a gradual decline in tree vigor. Stands are experiencing a gradual increase in susceptibility to disease and insect attack. Although dominated by ponderosa pine, it is the levels of Douglas-fir that are uncharacteristic for dry forests. Douglas-fir, along with shade tolerant grand fir, is more vulnerable to western spruce budworm, dwarf mistletoe, and fire. In the absence of fire or other disturbance, these stands will remain on their current trajectory in that Douglas-fir and grand fir will continue to develop in the understory.

Intermediate treatment would retain desirable species, within the limits of the existing stand characteristics. These treatments would maintain or increase the relative *proportion* of early seral tree species (ponderosa pine and western larch) and decrease the proportion of Douglas-fir, grand fir, and western juniper within the areas treated. Species composition would closely mimic historic stand conditions, based on our understanding of forest ecology for the Umatilla National Forest, as summarized in the Range of Variation Direction for Forest Vegetation Project Planning (Martin, 2010). Intermediate treatment would maintain the vigor of the residual ponderosa pine, western larch, and other desirable species in those stands where these species are competing for growing room (table 10, above). Follow-up treatments are needed if an objective is to maintain species composition within its historical range of variation.

Intermediate treatment would decrease stand densities by removing the relative proportion Douglas-fir, grand fir, ponderosa pine, and western juniper. As noted earlier, changes in overall densities will depend on overall acres treated, as depicted in table 11 below.

Table 11: Harvest Effects on Stand Density by Alternative for Dry Upland Forest. Areas in grey depict species outside of HRV. Grey shaded cells are outside historical range.

Stand Density Class	Dry Upland Forest Potential Vegetation Group									
	Historical Range		No Action, 2012		ALT 2 Post-Treatment		ALT3 Post-Treatment		ALT 4 Post-Treatment	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Per-cent	Acres	Percent
Low	10,800-22,950	40-85%	10,190	38%	20,320	75%	19,820	73%	19,360	72%
Moderate	4,050-8,100	15-30%	4,520	17%	2,380	9%	2,410	9%	2,470	9%
High	1,350-4,050	5-15%	12,270	45%	4,280	16%	4,750	18%	5,150	19%
Total			26,980	100%	26,980	100%	26,980	100	26,980	100%

Even with the moderate and high density classes outside historical range, the densities are favorable post treatment as they restore and promote open stand conditions. Treatment is also valuable because it reduces the vulnerability of forests to drought and similar climate change impacts (D’Amato et al. 2013). Through time, stand densities will continue to increase as long as there is growing space, which allows the low stand densities to transition into higher density classes. Follow-up treatments are to maintain forest vegetation within its historical range of variation.

Plant species associated with early successional stages are not expected to become widely established with intermediate harvest. Following treatment the existing understory vegetation is expected to continue to dominate these sites and would likely benefit from the associated post-harvest treatments. Stand-density reductions are expected to rejuvenate mountain mahogany, chokecherry, black hawthorn, serviceberry, snowberry, and other suppressed shrub species associated with dry-forest sites.

Harvest Effects on Stand Structure

Human influences have altered low-severity, high-frequency surface fires that historically occurred on a 5-20 year cycle. Treatment would allow the promotion and restoration of old forest stands dominated by ponderosa pine, as well as reestablish the frequent fire regime characteristics. Treatment would also allow development and maintenance of mature and late successional characteristics as the residual stand matures and changes over time (table 12).

Table 12: Harvest Effects on Structural Stage by Alternative for Dry Upland Forest. Areas in grey depict species outside of HRV. Grey shaded cells are outside historical range.

Forest Structural Stage	Dry Upland Forest Potential Vegetation Group									
	Historical Range		*Existing Conditions, 2012*		ALT 2 Post-Treatment		ALT3 Post-Treatment		ALT 4 Post-Treatment	
	Acres	Percent	*Acres*	*Percent*	Acres	Percent	Acres	Percent	Acres	Percent
SI: Stand Initiation	4,050-6,750	15-25%	*5,370*	*20%*	5,360	20%	5,360	20%	5,360	20%
SE: Stem Exclusion	2,700-5,400	10-20%	***9,000***	***33%***	***5,590***	***21%***	***5,580***	***21%***	***5,860***	***22%***
UR: Understory Reinitiation	1,350-2,700	5-10%	***8,760***	***32%***	***12,180***	***45%***	***12,190***	***45%***	***11,910***	***44%***
OFSS: Old Forest Single Stratum	10,800-16,200	40-60%	***1,450***	***5%***	***1,830***	***7%***	***1,830***	***7%***	***1,830***	***7%***
OFMS: Old Forest Multi-Strata	1,350-4,050	5-15%	*2,400*	*9%*	2,020	7%	2,020	7%	2,020	7%
Total			***26,980***	***100%***	**26,980**	**100%**	**26,980**	**100%**	**26,980**	**100%**

Stand structure is expected to change with a varying degree depending on acres treated. Although stem exclusion, understory re-initiation, and old forest single stratum remain outside historical range post treatment in all alternatives, they are favorable as they trend stands towards old forest dominated by ponderosa pine. Treatment in stem exclusion stands will transition the stands towards understory re-initiation and old forest single stratum, trending stem exclusion and old forest single stratum towards historical ranges. The largest increase occurs in the understory re-initiation stage. It is in the understory reinitiation stage where re-establishment of understory, a shift from density dependent to density independent tree mortality, and the development of decadence in the overstory trees occur (Franklin et al, 2002). From this decadence, stands can develop into old forests.

In all action alternatives, some level of maintenance burning is proposed as a means to restore and maintain ecosystem processes for dry forests. Stands currently dominated by shrubs, grasses and/or forbs with a few scattered large trees would be maintained in this structural stage by impacting trees in the smaller size classes and rejuvenating new growth that is indicative of dry forests, not to mention beneficial as browse to wildlife. An additional benefit to maintenance burning may be to provide a seed bed for regeneration and establishment of some early seral tree species. Non-forested shrub/grass-lands and open-canopy ponderosa pine old forest, both single and multi-stratum, are important elements in the ecosystems. Some areas would have saplings removed from the understory. This is designed to reduce ladder fuels and promote the maintenance of this older age class of trees. In stands with two or more layers (cohorts), the lower layers can functions as ladder fuels. The felled saplings will be limbed, lopped and scattered to reduce fuel concentrations and depth while increasing the rate at which this material decomposes on the site. This treatment will also have the long-term benefit of increasing the likelihood that overstory trees can sustain the effects of an underburn when that occurs and would promote the sprouting of browse species for wildlife benefit.

Harvest Effects on Reserve Trees

All harvest prescriptions emphasize development and retention of trees to function as future down woody debris, forest structure, relic overstory and future snag recruitment. Specific number and distribution of trees will vary with existing species composition, logging system, safety considerations, and site-specific resource objectives. Generally a minimum of 16-23 trees per acres (tpa) would be left in thinning units. In addition to providing long-term vertical diversity, these efforts would benefit snag-dependent wildlife species.

Monitoring of past logging projects indicates that the amount of damage to residual trees varies upon the number and distribution of the reserve trees, topography, species selection, logging system, and operator. Some reserve trees are expected to die or blow down, providing additional snag and down woody debris recruitment. While this does occur naturally, management activities can increase this risk within and adjacent to treatment areas.

All harvest units would retain recommended (USDA Forest Service, 1995) levels of downed woody material to provide habitat for small mammals, invertebrates, and enhance soil productivity. The volume and distribution of material will be specified in the silvicultural prescription and incorporated into the timber sale contract.

The effect on the stands not selected for treatment in the action alternatives would be the same as in Alternative 1.

Harvest Effects on Insects and Disease

Greater than 95 percent of the Kahler Dry Forest Restoration affected environment is comprised of ponderosa pine, Douglas-fir, grand fir that is vulnerable to insects and disease, specifically pine beetles and dwarf mistletoe. Whether or not management actions are taken, insects and pathogens will continue to play their role in modifying the forest vegetation. Mortality in ponderosa pine, Douglas-fir, and to some extent grand fir as a result of dwarf mistletoe will continue as the stands continue to mature. Pine beetle in the ponderosa pine as a result of ongoing infestation will also continue. However, the overall number of acres affected by bark beetles would likely remain the same for the next five to seven years.

Intermediate treatment would reduce densities of susceptible ponderosa pine, Douglas-fir and grand fir, providing improvement of general stand and tree vigor in the long run. Some prescribed fire treatments may experience a short term rise in beetle populations due to environmental stress from release and added stress related to prescribed fire. Generally, trees greater than 12 inches at DBH (diameter at breast height, 4.5 feet) have a higher probability of surviving prescribed fire, but the best success in in trees greater than 15 dbh.

Dwarf mistletoe will remain endemic within untreated areas. In treated areas more trees will be exposed to infection from surrounding resident populations, as mistletoe spread is affected by stand structure, tree size, species composition, and tree spacing. Spread in multi-storied stands is more rapid then single storied stands because the understory is showered with seeds from infected overstory (Hadfield et al, 2000). Harvest units with moderate amounts of mistletoe may exceed the 10 percent loss if logging and fuel treatments affect the residual trees. Historically wildfire has been natures primary control agent for dwarf mistletoe.

Effects of Road Closures on Forest Vegetation and Management

Following all post treatment activities temporary roads would be returned to natural conditions, eventually provide forest cover, although they would likely go through a prolonged period of grass, forbs and/or shrub dominance. Access to new construction and closed roads proposed for use would be controlled post treatment by gates or other closure devices. These closure devices allow for motorized access sometime in the future, which may help fire suppression and stand-tending operations such as pre-commercial thinning.

Cumulative Effects

Past, present, proposed, and reasonably foreseeable activities were reviewed to determine cumulative effects to forest vegetation. Timber harvest, tree planting, noncommercial thinning, and other past actions helped create existing conditions in the planning area. Beginning in the 1940s, partial removal or regeneration harvest has occurred on approximately 28,500 acres. These managed stands have a mixed species composition and contribute to the vegetative diversity mosaic that occurs in the planning area. Since the 1970s, approximately 2,500 acres have been partially cut or thinned resulting in a variety of stand conditions ranging from open to patchy, giving trees sufficient room to grow. Stand composition generally consists of early and late seral species.

Past Actions and their Effect on Current Conditions

Historically, the frequent fire regime has been an important factor in maintaining or enhancing early seral species across the Kahler fry forest restoration planning area, maintaining open stand conditions, reducing tree competition, and nutrient cycling. The natural disturbances have been replaced by fire suppression, which has been most effective in extinguishing low to mixed severity fires indicative of the dry forest ecosystems. The loss of these fires has resulted in increased tree canopy layers, higher surface and ladder fuels, and more shade intolerant species. Open forest conditions have given way to increased levels of stem exclusion and understory reinitiation conditions. Douglas-fir cover types are more prominent on the landscape, exceeding HRV. Stands are overstocked, with 45 percent of the affected environment having a stand density index greater than 121 (high density class).

Harvest entries in the planning area generally began in the 1940's, with significant regeneration harvests through the 1990's. Road construction and the associated removal of larger diameter trees resulted. Both artificial (planting) and natural regeneration were used to increase the abundance and survivability of seral species, which are better adapted to fire, and insects and diseases. In some cases, mechanical scarification was used to reduce shrub competition and create sites for newly planted seedlings.

Significant intermediate treatment decades occurred after 2000. Tree removal was focused on salvage of dead or dying trees, and thinning to emphasize a specific species composition, promotes tree growth, vigor, and yield. To date nearly 63% of the planning area has been previously harvested by single tree selection cuts or partial removals of generally large-diameter ponderosa pine and Douglas-fir.

Effects of Ongoing and Reasonably Foreseeable Actions

No reasonably foreseeable future actions are anticipated for the Kahler planning area over the next five years, as based on a review of the Umatilla National Forest's SOPA.

Combined Effects from Past, Proposed, Ongoing, and Foreseeable Actions

Approximately 90 percent of the intermediate treatment, depending on the action alternative, will overlap with previous actions due to their extent, placement of these treatments on the Kahler Dry Forest Restoration landscape, and the vegetative and functional recovery of past harvest units. By design, the proposed treatments are expected to trend stands towards historic species composition, stand densities, and stand structure levels. Additionally, conditions more typical of a frequent fire regime are created, as is improved growth potential with expected incremental improvement in resiliency. The silvicultural prescriptions prepared prior to implementation provide details of the target stand conditions and unit-specific treatment methodology.

Regulatory Consistency

Consistency of Proposed Silvicultural Activities with NFMA

The National Forest Management Act and the implementing regulations require specific findings to be made when implementing the Forest Plan (16 USC 1600 ET SEQ). Those findings include the following:

Suitability for timber production:

No timber harvest, other than salvage sales or sales to protect other multiple-use values, shall occur on lands not suited for timber production {16 USC 1604(k)}. This proposal includes timber harvest on:

(1) App. 30 acres of unsuitable land for which a site-specific FP amendment will authorize commercial timber harvest to address specific needs related to the Tamarack fire lookout administrative site.

(2) App. 680 acres (alternative 2) or 660 acres (alternative 3) of PACFISH class IV riparian habitat conservation areas where silvicultural activities will be implemented to help achieve riparian management objectives, as allowed by the PACFISH amendment to the Forest Plan – RHCAs are designated as unsuitable for timber production by the PACFISH amendment, but timber harvest is permissible if it contributes to attainment of riparian management objectives.

(3) App. 130 acres (in all action alternatives) of shrub-steppe enhancement associated with nonforest (shrub/herb) or woodland biophysical environments. This proposed treatment addresses juniper encroachment onto areas that historically supported important wildlife habitats consisting primarily of shrubland (e.g., bitterbrush, mountain-mahogany, etc.) and grassland species.

Clearcutting and even-aged management:

All proposed silvicultural activities are intermediate treatments such as commercial thinning, noncommercial thinning and shrub-steppe enhancements. Therefore, even-aged regeneration or clearcutting is not proposed for the Kahler planning area. The ID Team has determined that prescribing variable density thinning is optimal in order to increase patchiness more representative of the frequent fire regimes of dry forest ecosystems. Through variable density thinning, openings ranging in size from ½ to 2 acres will be created during implementation. These “gaps” are too small to qualify as clearcuts according to Forest Service policy.

Vegetation Manipulation:

The National Forest Management Act provides that timber harvest and other silvicultural practices shall meet multiple-use goals and objectives established for the Kahler planning area when considering the potential environmental impacts associated with their implementation. Harvest of trees provides social and economic benefit, restores dry forest ecosystems, reduces potential losses attributed to insects and diseases, and manipulates forest vegetation to enhance wildlife habitat and/or meet associate objectives. The silvicultural prescription which directs the vegetative management process is designed to meet Forest Plan goals, objectives, and guidelines for forest productivity and wildlife/fisheries habitat improvement while achieving ecosystem- based management.

Intermediate treatments are proposed in order to reduce stand densities, reduce incidence of Douglas-fir, to improve tree vigor of the desired leave trees particularly long-lived fire adapted species such as western larch and ponderosa pine, as well as maintain or enhance plant diversity. NFMA provides for these treatments where they increase the growth rate of residual trees, favor commercially valuable species, favor species valuable to wildlife, or achieve some other multiple use objectives.

Consistency with the Forest Land and Resource Management Plan

Umatilla National Forest Land and Resource Management Plan (LRMP) direction provides that integrated resource management activities will be used to "…Maintain or enhance ecosystem functions to provide for the long term integrity (stability) and productivity of biological communities". Integrated resources will also be used to emphasize multiple-use values coordinated with timber resource management, forest development and growth while producing cover for big game, protecting fisheries, maintaining near natural visual qualities, and reducing pest losses.

Implementation of Alternatives 2 and 3 require forest plan amendments related to Eastside Screens Wildlife Standard for harvest in old forest single and old forest multi-storied stands. No more than 7 percent of the old forest structure in the entire planning area is proposed for treatment. Emphasis is on dry forest restoration to promote and restore open stands of old forest dominated by ponderosa pine by trending stands towards historical range in structure, density, and species composition.

Management Areas Unsuitable for Timber Harvest

All action alternatives include proposed timber harvest in a Management Area (C1) that is designated as Unsuitable for Timber Harvest. Timber standards for C1- Dedicated Old Growth states, "*Timber management and harvest activities will not be scheduled or permitted"* (Chap 4, 4-146).

C1-Harvest around Tamarack Fire Lookout, Tamarack Rental Cabin, and the Tamarack Communication Tower is designed to reduce facility loss from wildfire, improve public and firefighter safety, and improve fire sighing capabilities from Tamarack Fire Lookout. All action alternatives would harvest approximately 10 acres of C1, requiring an amendment to the forest plan.

Destructive Pests

The Forest Plan identifies a goal to protect forest and range resources and values from unacceptable losses due to destructive pests (Chapter 4, 4-3). High density levels currently in a number of stands would result in an increased vulnerability to an array of insect and disease agents. All action alternatives are consistent with the goal of reducing this risk to varying degrees. These alternatives use treatments that would effectively treat stands with high stand densities, leading to an overall increased resilience or resistance to these agents and lowering the severity of fire effects within the stand. This would be accomplished by favoring retention of ponderosa pine, western larch and Douglas-fir.

Glossary

Active management: Human intervention into the nature, extent, and timing of disturbance to wildland ecosystems for the purpose of obtaining desired goods and services (Haeussler and Kneeshaw 2003). It has also been defined as the use of planning, thinning, prescribed fire, timber harvest, and reforestation to intentionally influence the health and resilience of a forest. In a climate-change context, active management refers to responses supporting ecosystem changes related to climate change (such as assisted species migration). For the Kahler planning area, active management involves application of silvicultural activities to modify existing vegetation conditions and move them toward desired vegetation conditions.

Activity fuel: Combustible material resulting from, or altered by, forestry practices such as timber harvest or thinning, as opposed to naturally created fuels (Helms 1998). Compare with: *natural fuel*. Also see: *fuel*.

Adaptation: A far-term climate change strategy adopting tactics such as minimizing negative ecosystem effects (reforest now with tree species expected to be tolerant of future droughts), or by exploiting potential opportunities to adapt to future climatic conditions. Adaptation is sometimes considered to be analogous with resilience. Adaptation and mitigation are important strategies, in some combination, to address climate change. For the Kahler planning area, both near-term mitigation and far-term adaptation actions are planned, as described in the climate change section of this report.

Adaptive management: A dynamic approach to land management in which the effects of treatments and decisions are continually monitored and used, along with research results, to modify management on a continuing basis to ensure that objectives are being met (Helms 1998).

Affected environment: In a NEPA context, this is a description of the environment of area to be affected by the alternatives under consideration (40 CFR 1502.15).

Bark beetles: Small, often cylindrical beetles in the family Scolytidae that bore through the bark of host trees to lay their eggs and, as larvae, they tunnel and feed in the inner bark (Doliner and Borden 1984). For the Kahler planning area, bark beetles of particular concern include: Douglas-fir beetle, which affects older and larger Douglas-fir; mountain pine beetle, which affects second-growth ponderosa pine forest; fir engraver, which affects older and larger grand fir; and western pine beetle, an important killer of older and larger ponderosa pine.

Basal area: The surface area of a woody stem (or stems), including bark, as if cut off at a certain height (such as breast height or 4½ feet above the ground); also, the surface area of all stems in a stand and expressed per unit of land area (basal area per acre) (Jennings et al. 2003). Basal area is a way to measure how much of a site is occupied by trees.

Biological diversity (biodiversity): The variety of all fauna, flora, and microbes, and their habitats. Biodiversity is hierarchical, ranging from genetic diversity to species diversity and then ultimately ecosystem diversity (Powell et al. 2001).

Biophysical environment: Landscape-level unit of vegetation composition and structure, with its associated environmental gradients and processes of change (Powell et al. 2007). Note that ‘biophysical’ refers to a combination of biological and physical components of an ecosystem. For the Kahler planning area, potential vegetation groups (PVGs) are used as biophysical environments.

Breast height: A standard height from ground level, generally 4.5 feet (1.37 m), for recording diameter, circumference (girth), age, or basal area of a tree (adapted from Helms 1998). Measurement at breast height is usually taken on the uphill side of the tree and includes any duff layer that may be present, but does not include unincorporated woody debris lying upon the ground surface (Helms 1998).

Burn severity: Fire severity and burn severity are sometimes used interchangeably. Note that burn severity relates specifically to soils, particularly to the loss of organic matter from, and directly above, the mineral soil (Keeley et al. 2009). Compare with: *fire severity*.

Climax: The culminating seral stage in plant succession for any given site where, in the absence of catastrophic disturbance, the vegetation has reached a highly stable condition and undergoes change very slowly (Dunster and Dunster 1996). The stage of plant development in which vegetation is thought to be stable, self-sustaining, and self-replicating. Also refer to: *seral stage: potential natural community*.

Cohort: A group of trees developing after a single disturbance, commonly consisting of trees of similar age, although one cohort can include a considerable span of ages ranging from seedlings or sprouts to trees that predated the disturbance (Helms 1998). Stands are often characterized as single-cohort or multicohort depending on whether they contain one or several cohorts (Oliver and Larson 1996). Also see: *structural stage*.

Commercial thinning: Any type of tree thinning producing merchantable material at least equal in value to the direct costs of timber harvest.

Community: In an ecological context, a community is made up of all of the interacting populations in an environment. Community refers to a group of organisms that tends to occur together under similar environmental conditions, occupying the same habitat or area and interacting with each other (Doliner and Borden 1984). Community is usually considered to be a smaller spatial scale than an ecosystem.

Competition: Negative interactions between individuals of either the same or different species that utilize common and limited resources such as nesting sites, nutrients, or prey (Doliner and Borden 1984). For trees, competition results in a density-related scarcity of certain environmental factors, primarily relating to soil moisture and nutrients, that are important for tree growth and survival (Helms 1998).

Connectivity: Ecological conditions existing at several spatial and temporal scales and providing landscape linkages to permit the exchange of water flow, sediments, and nutrients; daily and seasonal movements of animals within home ranges; dispersal and genetic interchange between populations; and long distance range shifts of species, such as in response to climate change (USDA Forest Service 2012a).

Cover type: The plant species forming a plurality of the composition across a given land area, e.g., the Engelmann spruce-subalpine fir, ponderosa pine-Douglas-fir, or lodgepole pine forest cover types (Helms 1998). Forest cover types of the United States and Canada are described in Eyre (1980). Rangeland cover types of the United States are described in Shiflet (1994).

Crown class: A categorization or classification of trees based on their crown position relative to adjacent trees within the same canopy stratum; four primary crown classes are recognized:

Dominant: A tree whose crown extends above the general level of the main canopy, receiving full light from above and partial light from the sides.

Co-dominant*:* A tree whose crown helps to form the general level of the main canopy, receiving full light from above and limited light from the sides.

Intermediate*:* A tree whose crown extends into the lower portion of the main canopy but is shorter than the co-dominants, receiving little direct light from above and virtually none from the sides.

Subcanopy (overtopped): A tree whose crown is completely overtopped by the crowns of one or more neighboring trees, occurring in a subordinate or submerged position relative to the main canopy.

Crown fire: An intense fire that burnt through the upper tree or shrub canopy, spreading from one woody crown to another above the ground. In most cases the understory vegetation is also burned. Depending on species, a crown fire may or may not be lethal to all dominant vegetation. An example of this would be many shrub and broadleaf tree species that sprout from roots, root crowns, or stem bases after their tops are killed. A crown fire may be continuous, or it may occur as patches within a lower severity burn (Sommers et al. 2011). Three types of crown fire are commonly recognized:

Passive crown fire: This crown fire type is characterized by the torching of a small group of trees (Stephens et al. 2012); a solid or continuous flaming front, in canopy fuels, cannot be maintained except for short periods.

Active crown fire**:** This crown fire type is characterized by fire spreading continuously in canopy fuels. Two types of active crown fire are recognized:

Independent crown fire**:** This crown fire type spreads without the aid of a supporting surface fire (Sommers et al. 2011). For example, a strongly wind-driven, independent crown fire is sometimes observed in boreal forest during late winter or spring when snow still covers surface fuels.

Dependent crown fire**:** This crown fire type spreads in canopy and surface fuels simultaneously (Stephens et al. 2012). For the Kahler planning area, many of the silvicultural activities proposed for implementation, including prescribed fire, are designed to minimize future risk of dependent crown fire.

Danger tree: A tree, or its parts, that is likely to fail within one and ½ tree lengths of an open class 3 or higher system road, any road designated for timber hauling, or a developed recreation or administrative site (Toupin et al. 2008). Also known as: *hazard tree*.

Desired future conditions (desired conditions): A description of the land or resource conditions that are believed necessary if goals and objectives are to be fully achieved (Helms 1998).

Disease: Any more or less prolonged disturbance of an organism that interferes with its normal structure or function; the causes of disease are both biotic and abiotic (Doliner and Borden 1984).

Disturbance: A relatively discrete event that disrupts the structure of an ecosystem, community, or population, and changes resource availability or the physical environment. Disturbances include processes such as fires, floods, insect outbreaks, disease epidemics, and windstorms (Dodson et al. 1998).

Disturbance regime: A description of the characteristic types of disturbance on a given landscape; the frequency, severity, and size distribution of these characteristic disturbance types; and their interactions (USDA Forest Service 2012a). Description of a disturbance regime would include characteristics such as the spatial distribution of disturbance events; disturbance frequency (number of disturbance events in a specified time interval, or the probability of a disturbance event occurring within a particular time interval); return interval (average time between successive disturbance events); rotation period (length of time until an area equivalent to the size of an planning area would be affected in one disturbance event); disturbance size; and the magnitude, or intensity, of a disturbance event (Dodson et al. 1998).

Dripline: The width of a tree crown, measured as the outermost point at which a drop of water would fall vertically from the crown foliage and reach the ground rather than other foliage. It is expressed as either a radial distance from the tree trunk (bole, stem) to the dripline, or as a diameter of the area encompassed from one edge of the dripline to the other (Dunster and Dunster 1996).

Dry upland forest: A potential vegetation group associated with biophysical environments where the climate, soil depth, and other physical site factors allow development of a tree-dominated ecosystem supporting vegetation types characteristic of relatively warm or hot temperature conditions, and dry or xeric moisture regimes (Powell et al. 2007).

Eastside Screens: A Regional Forester's Plan Amendment establishing riparian, ecosystem, and wildlife standards specifically for timber sales.

Ecological integrity: The quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation, and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence (USDA Forest Service 2012a).

Ecosystem: A spatially explicit, relatively homogeneous unit of the Earth that includes all interacting organisms and elements of the abiotic environment within its boundaries. An ecosystem is commonly described in terms of its: (1) Composition. The biological elements within the different levels of biological organization, from genes and species to communities and ecosystems. (2) Structure. The organization and physical arrangement of biological elements such as, snags and down woody debris, vertical and horizontal distribution of vegetation, stream habitat complexity, landscape pattern, and connectivity. (3) Function. Ecological processes that sustain composition and structure, such as energy flow, nutrient cycling and retention, soil development and retention, predation and herbivory, and natural disturbances such as wind, fire, and floods. (4) Connectivity. (USDA Forest Service 2012a). Also see: *connectivity*.

Ecosystem services: Ecosystem services include provisioning services such as food, water, timber, and fiber; regulating services affecting climate, floods, disease, wastes, and water quality; cultural services providing recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling (Hassan et al. 2005).

Even-aged stand: A stand of trees composed of a single age class (USDA Forest Service 2012a).

Existing vegetation: Vegetation found at a given location at the time of observation (Jennings et al. 2003). Compare with: *potential vegetation*.

Fire: A self-sustaining chemical reaction releasing energy in the form of light and heat (Brenner 1998). Four types of fire are commonly recognized (arranged from least intense to most intense):

> ***Ground fire***: Fires burning in surface organic materials such as peat or deep duff layers. Ground fires typically undergo a large amount of smoldering combustion and less active flaming than other fire types. They may kill roots of overstory species due to prolonged high temperatures in the rooting zone (Sommers et al. 2011).
>
> **Surface fire:** Fires burning only the lowest vegetation layer, which may consist of grasses, herbs, low shrubs, mosses or lichens (live fuels), and dead tree foliage and branchwood cast into the surface fuelbed from the overstory canopy. In forests, woodlands, or savannas, surface fires are generally low to moderate severity, and do not cause extensive overstory mortality (Sommers et al. 2011).
>
> **Mixed-severity fire:** For this fire regime, fire severity varies between nonlethal understory fire and lethal stand replacement fire, with the variation occurring in space (between polygons) or time (within the same polygon). In some vegetation types, the stage of succession, the understory vegetation structure, the fuel condition, or the weather may determine whether a low or high-severity (or surface or crown) fire occurs. In this scenario, individual fires vary over time between low-severity surface fires and longer-interval stand replacement fires. In other situations, the severity may vary spatially as a function of landscape complexity or vegetation pattern, in which case the result may be a mosaic of young, old, and multi-aged vegetation patches (Sommers et al. 2011).
>
> **Stand replacement fire:** A fire that is lethal to most of the dominant, above-ground vegetation, with the result that it substantially changes the vegetation structure. Stand replacement fires may occur in forests, woodlands and savannas, annual grasslands, and shrublands. Depending on the vegetation type being affected, stand replacement fire may result from crown fire, high-severity surface fire, or ground fire (Sommers et al. 2011). Also see: *crown fire*.

Fire behavior: This term relates to the manner in which fire reacts to fuel, weather, and topography; common terms used to describe fire behavior include smoldering, creeping, running, spotting, and torching (Sommers et al. 2011).

Fire exclusion: Areas where wildland fires were eliminated, including areas historically exposed to traditional Native American burning (Rapp 2002).

Fire frequency: The number of times that fire occurs within a defined geographical area and during a specific time period. Fire frequency is sometimes characterized by using fire return intervals: very frequent (0-25 years between fires); frequent (26-75 years); and infrequent (76-150 or more years) (Sommers et al. 2011).

Fire intensity: Fire intensity describes the physical combustion process of energy release from organic matter. It is often expressed as fireline intensity – the rate of heat transfer per unit length of fireline. Since there is often a consistent relationship between fireline intensity and flame length, flame length may be used as a measure of fireline intensity (Keeley et al. 2009). Three intensity classes are recognized: low (average flame length of less than 3 feet), intermediate (average flame lengths of 3 to 9 feet), and high (flame lengths exceed 9 feet).

Fire regime: A fire regime is a generalized description of the role fire plays in an ecosystem (Agee 1993). When characterizing a fire regime, the following attributes are often included: frequency, magnitude (intensity and/or severity), variability, seasonality, synergism, and extent (Agee 1998). Note that many fire regime classification systems exist; a recent one recognizes three primary regimes for forested environments (Brown and Smith 2000): (1) understory – fires are generally nonlethal to dominant vegetation (80% or more survives), and they do not change its structure; (2) mixed severity – fire either causes selective mortality in dominant vegetation (depending on its fire tolerance), or it varies between the understory and stand-replacement modes; and (3) stand replacement – fire kills or consumes the dominant vegetation (80% or more is either killed or consumed), and the forest structure is changed substantially. Compare with: *disturbance regime*.

Fire return interval: This metric describes the time between fires in a defined area, usually at the scale of a point, stand, or relatively small landscape area. This is called Mean Fire Interval (MFI) in the LANDFIRE system, when it refers to the average number of years between fires in representative stands (Barrett et al. 2010).

Fire severity: Fire severity relates to the loss (death) or decomposition of organic matter both aboveground and belowground, including tree mortality as a 'loss' component, but this mortality context is most appropriate for trees lacking any sprouting capacity. Fire severity is correlated with fire intensity (Keeley et al. 2009). Compare with: *fire intensity*.

Fire suppression: All activities associated with controlling and extinguishing a fire following its detection (Dunster and Dunster 1996). Compare with: *fire exclusion*.

Forest: An ecosystem characterized by more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species composition, structure, age class, and associated processes, and commonly including meadows, streams, fish, and wildlife (Helms 1998).

Forest density management: Cutting or killing trees to increase inter-tree spacing and accelerate growth of remaining trees; the manipulation and control of forest (tree) density to achieve one or more resource objectives. Forest density management is often used to improve forest health, to open the canopy for selected trees, to maintain understory vegetation, or to promote late-successional characteristics for biological diversity (Helms 1998).

Forest floor: A general term encompassing the layer of undecomposed organic matter (leaves, twigs, and plant remains in various stages of decomposition) lying on top of the mineral soil (Dunster and Dunster 1996).

Forest health: The perceived condition of a forest based on concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance. Note that perception and interpretation of forest health is influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of stands comprising the forest, and the appearance of a forest at any particular point in time (Helms 1998).

Forest management: Intentional manipulation of forest ecosystems to influence their composition, structure, or density, and the nature of the products and services they provide (Burger 2009). Also see: *active management*. For the Kahler planning area, forest management involves application of silvicultural activities to modify existing vegetation conditions and move them toward desired vegetation conditions.

Forest stand: A contiguous group of trees sufficiently uniform in age-class distribution, composition and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit (Helms 1998). For the Kahler planning area, forest stands (e.g., vegetation polygons) were used as the base-level planning unit, although similar stands are aggregated into treatment units when silvicultural activities are implemented on the ground.

Fuel: All of the dead and living material in an ecosystem that will burn; fuel includes grasses, dead branches and pine needles on the ground, as well as standing live and dead trees (Brenner 1998). Four types of fuel are commonly recognized (arranged from lowest to highest):

Ground fuel: A fuel component consisting of duff (the Oi soil horizon) and other materials (such as peat) lying on top of a mineral soil surface; ground fuels generally do not contribute to wildfire spread or intensity (Stephens et al. 2012).

Surface fuel**:** A fuel component including dead and down woody materials, litter, grasses, other herbaceous plant material, and short shrubs; surface fuels may be the most hazardous fuel component for some forest types (Stephens et al. 2012).

Ladder fuel: A fuel component consisting of small trees or tall shrubs providing vertical continuity from surface fuels to canopy (crown) fuels (Stephens et al. 2012). Ladder fuels are important for initiating crown fire, but they have little influence on crown fire spread.

Crown fuel: A fuel component comprised of overstory tree crowns and canopies (including foliage and small branches); note that the canopy and crowns of small trees (seedlings and saplings) are often included in the ladder-fuels category. Of the three primary fuel components (surface, ladder, crown fuels), fire scientists often consider crown fuels to be the least hazardous (Stephens et al. 2012), but my experience is that this sentiment is seldom shared by managers and practitioners. Crown fuels are typically quantified as canopy bulk density – the mass of available canopy fuel per unit of canopy volume, often expressed as kilograms per cubic meter.

Fuel load: The amount of combustible material (living and dead organic matter) that is found in an area (Brenner 1998).

Fuel management or treatment: Any manipulation or removal of fuels to reduce the likelihood of fire ignition, lessen potential fire-caused damage, and improve resistance to control.

Gap: In forestry usage, a gap is a space left in the canopy when one or more trees die, or after they are removed during timber harvest. Gaps are used in association with variable-density thinning to create habitat for regeneration of shade-intolerant species including shrubs and herbs (Franklin et al. 2013). Compare with: *skip*.

Grapple piling: This fuels treatment activity utilizes mechanical equipment to pile woody material from two to nine inches in diameter and more than six feet in length.

Growing space: An intangible measure of the total resources of a site (sunlight, moisture, nutrients, etc.) available to a plant (Helms 1998). Growing space refers to the availability of all resources needed by a plant to exist on a given site (O'Hara 1996).

Harvest: See: *timber harvest*.

Hazard: Stand, tree, and environmental characteristics that are conducive to an insect outbreak or disease infection (Doliner and Borden 1984). The term hazard is also used to describe a tree, or its parts, that could fail and injure or kill people (see: *danger tree*). Compare with: *susceptibility*.

ICO (Individuals, Clumps, and Openings): The ICO thinning "approach provides quantitative targets for spatial pattern based on historical or contemporary reference sites. Pattern is expressed in terms of the number of individual trees, and small, medium, and large tree clumps to leave in a stand (Churchill et al., 2013). Instead of marking for a specific range of basal areas, marking crews identify and track the number of clumps they retain while incorporating other leave tree criteria" (Franklin et al. 2013, p. 122). The specifics of ICO implementation are described in Churchill et al. (2013b).

Indicator species: Species used to monitor environmental change or represent specific environmental conditions (Eycott et al. 2007), including plant species conveying information about the ecological nature of a site, such as the nitrogen content, or the alkalinity or acidity of its soils. These plant species have a sufficiently consistent association with a specific environmental condition, or with other species, such that their presence can be used to indicate or predict the environmental condition, or a potential for the other species (Kimmins 1997).

Intermediate cutting: Any cutting method used in a stand between the time of its formation (seedling stage) and its regeneration as a mature stand. Commercial thinning, noncommercial thinning, and improvement cutting are three examples of intermediate cutting methods.

Irregular stand: A stand of trees characterized by variation in age structure or in the spatial arrangement of trees; stands without a uniform age or size structure (Helms 1998). Analysis of historical inventory data collected from mature stands in 1910-1911 (Munger 1917) suggests that dry-forest stands had a structure closer to irregular than to classical even-aged or classical uneven-aged (Powell 1999).

Keystone species: Species with ecosystem effects that are disproportionately large in comparison to their biomass or number (Eycott et al. 2007). The gopher tortoise, for example, is a keystone species because more than 330 other species use its burrows (Simberloff 1999).

Ladder fuel: See: *fuel*.

Landscape: A defined area irrespective of ownership or other artificial boundaries, such as a spatial mosaic of terrestrial and aquatic ecosystems, landforms, and plant communities, repeated in similar form throughout such a defined area (USDA Forest Service 2012a).

Landscape ecology: A study of structure, function, and change in a heterogeneous land area composed of interacting ecosystems (Forman and Godron 1986). Some landscape ecologists classify the spatial elements of a landscape into three primary components:

> ***Matrix:*** The most extensive and most connected landscape element; it plays a dominant role in landscape function. The matrix is the landscape element surrounding a patch.
>
> **Patch:** A nonlinear land area differing in appearance from its surroundings, which is typically the matrix. Patches are a landscape element distinct from the matrix and isolated from other similar areas (patches).
>
> **Corridor:** A narrow, linear land feature differing from the matrix or a patch on either side. Riparian habitats along streams or rivers often function as corridors (Forman and Godron 1986).

Layer (vegetation): A structural component of a plant community consisting of plants of approximately the same height stature (e.g., tree, shrub, and herb layer); as defined here, synonymous with stratum (Jennings et al. 2003).

Lifeform: The structure, form, habits, and life history of an organism. In plants, characteristic life forms such as forest (trees), shrubs, and herbs (forbs/graminoids) are based on morphological features (physiognomy or predominant stature) that tend to be associated with different environments (Allaby 1998).

Litter: Dead debris (plant material) covering the ground, including cones, needles or other shed foliage, branches, and other material (Brenner 1998).

Management area: A land area identified within the planning area that has the same set of applicable plan components. A management area does not have to be spatially contiguous (USDA Forest Service 2012a).

Marking guides: Marking guides are written direction, generally prepared by a certified or qualified silviculturist, to provide silvicultural guidelines or specifications for selecting trees to retain, or optionally trees to remove, in order to accomplish specific stand management objectives.

Mastication: This fuels treatment activity utilizes mechanical equipment to chunk, pulverize, or grind, and scatter, both natural and harvest-generated fuels.

Mechanical treatment: Mechanical treatment refers to the use of tractors or other machinery to remove trees in a tree harvest operation (stewardship harvest), or to the use of hand-operated tools (chain saws, axes, etc.) to cut, clear, thin, girdle or prune woody plant species (Powell et al. 2001).

Mitigation: A near-term climate change strategy adopting tactics such as reducing greenhouse gas emissions (by reducing wildfire emissions, for example), or by enhancing carbon uptake and storage. Mitigation is sometimes considered to be analogous to resistance. Near-term mitigation and far-term adaptation are important strategies, in some combination, to address climate change.

Moist upland forest: A potential vegetation group associated with biophysical environments where the climate, soil depth, and other physical site factors allow development of a tree-dominated ecosystem supporting vegetation types that are characteristic of relatively moderate or intermediate temperature conditions, and a moist or mesic moisture regime (Powell et al. 2007).

Monitoring: A systematic process of collecting information to evaluate effects of management actions, or changes in conditions or relationships (USDA Forest Service 2012a).

Native knowledge: A way of knowing or understanding the world, including traditional ecological and social knowledge of the environment derived from multiple generations of indigenous peoples' interactions, observations, and experiences with their ecological systems. Native knowledge is place-based and culture-based knowledge in which people learn to live in and adapt to their own environment through interactions, observations, and experiences with their ecological system. This knowledge is generally not solely gained, developed by, or retained by individuals, but is rather accumulated over successive generations, and is expressed through oral traditions, ceremonies, stories, dances, songs, art, and other means within a cultural context (USDA Forest Service 2012a).

Native species: An organism that historically, or currently, is present in a particular ecosystem as a result of natural migratory or evolutionary processes; it is not present as a result of accidental or deliberate introduction into the ecosystem.

Natural fuel: Combustible material resulting from natural processes and not directly generated or altered by land management practices (Helms 1998). Compare with: *activity fuel*. Also see: *fuel*.

Natural regeneration: The renewal of a forest community by natural (as compared to human) means, such as tree seedling establishment from seed on-site, from adjacent areas, or seed brought in by wind currents, birds, or animals.

Nature: This term has been used to mean the natural world on Earth as it exists without human beings or civilization, that is, the environment including mountains, plains, rivers, lakes, oceans, air, and rocks, along with all other nonhuman, non-domesticated, living things (Botkin 1990a).

Noncommercial thinning: A treatment in immature forests designed to reduce tree density and thereby improve growth of the residual trees, enhance forest health, or anticipate future mortality resulting from intertree competition. Noncommercial (also known as precommercial) thinning involves situations where trees being cut are too small to be sold for conventional wood products, so they are typically left on site by either lopping them into pieces and scattering the pieces close to the ground, or aggregating them into piles that are later burned (Powell et al. 2001).

Old forest: A forest structural stage characterized by a predominance of large trees (> 21" dbh) in a stand with either one or multiple canopy layers. On warm dry sites that historically featured frequent, low-severity surface fires, a single stratum may be present containing 10 or more trees >21" dbh per acre (old forest single stratum; OFSS). On cool moist sites where surface fire was relatively uncommon, multi-layer stands with at least 10 (or 20 for sites with higher productivity) large trees (> 21" dbh) per acre in the uppermost stratum are typically found (old forest multi strata; OFMS). Compare with: *old growth*.

Old growth: Forest stands distinguished by old trees and related structural attributes such as tree size, accumulations of large dead woody material, number of canopy layers, species composition, and ecosystem function (Newton 2007). For national forest system lands in the Pacific Northwest, characteristics (attributes) of old-growth forests are described in USDA Forest Service (1993). Compare with: *old forest*.

Outbreak: A sudden increase in destructiveness or population level of a pest species in a given area; usually used in reference to bark beetles, defoliators, and other forest insects (Doliner and Borden 1984).

Overstory: For a stand of trees, overstory is the upper canopy layer; small trees established beneath the upper canopy layer are termed understory. Compare with: *understory; undergrowth*.

Pathogen: Any agent, whether a living organism or abiotic factor, that induces disease (Doliner and Borden 1984).

Plant association: A plant community with similar physiognomy (form and structure) and floristics; commonly it is a climax community (Allaby 1998). It is believed that 1) the individual species in the association are, to some extent, adapted to each other; 2) the association is made up of species that have similar environmental requirements; and 3) the association has some degree of integration (Kimmins 1997). Also see: climax; seral stage: potential natural community.

Plant association group (PAG): Groupings of plant associations (and other potential vegetation types such as plant communities and plant community types) representing similar ecological environments, as defined by using temperature and moisture regimes (Powell et al. 2007).

Plant community: A naturally occurring assemblage of plant species living in a defined area or habitat (USDA Forest Service 2012a). In a vegetation classification context: (1) a plant community has no particular successional (seral) status; (2) plant communities represent vegetation types with a restricted geographical distribution; and (3) plant communities have such a small number of sample plots that it is not possible to infer their true successional status (Johnson and Clausnitzer 1992).

Plant community type: An aggregation of all plant communities with similar structure and floristic composition. A vegetation classification unit with no particular successional status implied (Dunster and Dunster 1996).

Plant succession: The process by which a series of different plant communities, along with associated animals and microbes, successively occupy and replace each other over time in a particular ecosystem or landscape location following a disturbance event (Kimmins 1997). The process of development (or redevelopment) of an ecosystem over time (Botkin 1990a).

Potential vegetation: The vegetation that would become established if successional sequences were completed without interference by man or natural disturbance under present climatic and edaphic conditions; the plant community developing if all successional sequences were completed under existing site conditions (Dunster and Dunster 1996). Also see: climax; seral stage: potential natural community.

Potential vegetation group (PVG): An aggregation of plant association groups (PAGs) with similar environmental regimes and dominant plant species. Each PVG includes PAGs representing a similar temperature or moisture influence (Powell et al. 2007).

Prescribed fire: Deliberate burning of wildland fuels in either a natural or modified state, and under specified environmental conditions, in order to confine the fire to a predetermined area, and to produce a fireline intensity and rate of spread meeting land management objectives (Powell et al. 2001). Three specific types of prescribed fire will be used to help manage both natural and activity fuels:

> ***Jackpot burn:*** A method for burning activity-created fuels in which only the larger fuel concentrations are ignited, and the resulting fire is confined to these locations.
>
> ***Pile burn:*** A method for burning activity-created fuels that were first piled by using mechanical equipment, or by hand, with an objective of reducing fuel loading to prescribed levels.
>
> ***Underburn:*** Application of prescribed burning in activity-created or natural fuels located beneath a tree canopy, usually with an objective of ensuring survival of dominant, overstory trees.

Purpose and need statement: In a NEPA context, this is a brief statement specifying the underlying purpose of a project, and the need to which an agency is responding (40 CFR 1502.13).

Range of variation: A characterization of fluctuations in ecosystem conditions or processes over time; an analytical technique used to define the bounds of ecosystem behavior that remain relatively consistent through time (Morgan et al. 1994). Values of composition, structure, density or another attribute, and falling between upper and lower bounds determined for the attribute (Jennings et al. 2003), are said to be within the range of variation. Attributes whose values occur above the upper bound are said to be 'over-represented;' attributes whose values are below the lower bound are said to be 'under-represented.' Also see: *reference conditions*.

Reburn: The repeat burning of an area over which a fire has previously passed, but has left unburnt fuel (Helms 1998).

Reference conditions: A reference ecosystem or reference conditions can serve as a model for planning ecosystem restoration activities. In its simplest form, the reference is an actual site, its written description (such as historical accounts of a reference area), or both (SERI 2004). Reference conditions also refer to a range of variation in ecological structures and processes, reflecting recent evolutionary history and the dynamic interplay of biotic and abiotic factors. Reference conditions generally reflect ecosystem properties that are free of major influence by Euro-American humans (Kaufmann et al. 1994).

Reforestation: The restocking of an area with forest trees by either natural or artificial means, including out-planting of tree seedlings produced by a nursery.

Resilience: Intrinsic properties allowing the fundamental functions of an ecosystem to persist in the presence of disturbance; the 'bounce-back' capability of a system to recover from disturbance. "Ecological resilience is the capacity of an ecosystem to absorb disturbance and undergo change while maintaining its essential functions, structures, identity, and feedbacks. Resilience is often synonymous with adaptive capacity, i.e., the ability of a system to reconfigure itself in the face of disturbance or stresses without significant decreases in critical aspects such as productivity or composition" (Drever et al. 2006). Resilience recognizes that systems have a capacity to absorb disturbance, but this capacity has limits and when they are exceeded, the system may rapidly transition to a different state or developmental trajectory (Gunderson et al. 2010). In a climate-change context, resilience is sometimes viewed as analogous to adaptation.

Resistance: Resistance refers to the ability of an ecosystem to remain relatively unchanged in the face of external forces such as disturbance (pulse-type changes) or climate change. Resistance is sometimes viewed as being analogous to stability (Holling 1973), but in a climate-change context, it is often viewed as analogous to mitigation.

Restoration: Restoration involves holistic actions taken to modify an ecosystem to achieve desired, healthy, and functioning conditions and processes. This term is generally used to refer to the process of enabling a system to resume acting, or continuing to act, following disturbance as if disturbance had not occurred (Powell et al. 2001). Restoration is a process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on reestablishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystem sustainability, resilience, and health under current and future conditions (USDA Forest Service 2012a). Two restoration approaches have been described:

> **Active restoration"** An approach involving implementation of active management practices (prescribed fire, thinning, etc.) to restore appropriate composition, structure, or density conditions.
>
> **Passive restoration:** An approach involving removal of stressors causing ecosystem degradation, such as cessation of fire exclusion in fire-dependent ecosystems (Rapp 2002).

Riparian areas: Three-dimensional ecotones of interaction between terrestrial and aquatic ecosystems extending down into the groundwater, up above the canopy, outward across the floodplain, up nearby side-slopes draining to the water, laterally into the terrestrial ecosystem, and along the water course at variable widths (USDA Forest Service 2012a).

Riparian forest: A physiognomic class supporting a forest ecosystem, and occurring on riparian landforms or biophysical environments (Powell et al. 2007). See: *riparian areas*; *forest*. Compare with: *upland forest*.

Riparian management zone (riparian habitat conservation areas; RHCAs): Portions of a watershed where riparian-dependent resources receive primary emphasis, and for which plans include plan components to maintain or restore riparian functions and ecological functions (USDA Forest Service 2012a).

Risk: A combination of the likelihood that a negative outcome will occur (as related to susceptibility and vulnerability), and severity of the resulting negative consequences (USDA Forest Service 2012a). Note that risk refers to an event with a known occurrence probability, whereas uncertainty refers to an event with an unknown probability.

Seral stage: Identifiable stages in the development of a sere, from an initial pioneer stage, through various early and mid-seral stages, to late seral, subclimax, and climax stages. The stages are identified by different plant communities, different ages of the dominant vegetation, and by different microclimatic, soil, and forest conditions (Kimmins 1997). Four seral stages are recognized (Hall et al. 1995):

> ***Early Seral:*** Clear dominance of early-seral species (western larch, ponderosa pine, lodgepole pine, etc.) is evident; PNC species are absent or present in very low numbers.
>
> ***Mid Seral:*** PNC species are increasing in the forest composition as they actively colonize the site (or as they continue an ongoing developmental process); PNC species are approaching equal proportions with early- and mid-seral species.
>
> ***Late Seral:*** PNC species are now dominant, but long-lived early- and mid-seral species (ponderosa pine, western larch, etc.) may still persist in the plant community.

Potential Natural Community (PNC): The biotic community that one presumes would be established and maintained over time under present environmental conditions; early- and mid-seral species are scarce or absent in the plant composition.

Severity: Proportion of the organic matter lost from the vegetation and surface soils due to disturbances (Chapin et al. 2002).

Shade tolerance: The capacity of trees to grow satisfactorily in the shade of, and in competition with, other trees (Helms 1998). Also see: *tolerance*.

Shrub-steppe: Shrub-steppe ecosystems have been defined as plant "communities consisting of one or more layers of perennial grass above which there rises a conspicuous but discontinuous layer of shrubs" (Daubenmire 1970, p. 83). In the southeastern Washington and northeastern Oregon portions of the interior Columbia River basin, shrub-steppe plant communities often feature bitterbrush, big sagebrush, stiff sagebrush, or threetip sagebrush as primary shrub species, and bluebunch wheatgrass, Idaho fescue, basin wildrye, or Thurber's needlegrass as common grass species (Daubenmire 1970, Franklin and Dyrness 1973).

Silvicultural prescription: A planned series of treatments designed to change current forest structure to one meeting the goals and objectives established for an area (Helms 1998). A prescription is a written statement or document defining the outcomes to be attained from silvicultural treatments; outcomes are generally expressed as acceptable ranges of the various indices being used to characterize forest development (Dunster and Dunster 1996).

Silvicultural treatment: An activity, practice, or action that can be applied in a controlled manner, according to the specifications of a silvicultural prescription or forest plan, to improve actual or potential conditions or benefits (Hoffman et al. 1999).

Silviculture: Applying techniques or practices to manipulate forest vegetation by directing stand and tree development, and by creating or maintaining desired conditions. Silviculture is based on an ecosystem concept that emphasizes the need to evaluate the many abiotic and biotic factors influencing the choice and outcome of silvicultural treatments and their sequence over time, and the long-term consequences and sustainability of management regimes. [Definition derived from multiple sources.]

Skip: In forestry usage, skips include one or more portions of a stand, or a timber sale treatment unit, which are not to be entered during timber harvest activity. Compare with: *gap*.

Soil compaction: The process by which soil grains or particles are rearranged, resulting in a decrease in void space and causing closer contact with one another, thereby increasing bulk density (Helms 1998).

Species diversity: Number, evenness, and composition of species in an ecosystem; the total range of biological attributes of all species present in an ecosystem (Chapin et al. 2002).

Stewardship: Taking a long-term and integrated view of resource management – air, water, land, plants, and animals – recognizing the dependent relationships of humans on the environment, and that environmental health is fundamental to economic and human health (British Columbia Habitat Branch 2000).

Stressors: Factors that may directly or indirectly degrade or impair ecosystem composition, structure, or ecological process in a manner that may impair its ecological integrity, such as an invasive species, loss of connectivity, or the disruption of a natural disturbance regime (USDA Forest Service 2012a).

Structural stage: A stage or recognizable condition that relates to the physical orientation and arrangement of vegetation; the size and arrangement (both vertical and horizontal) of trees and tree parts. The following structural stages have been described (O'Hara et al. 1996, Oliver and Larson 1996):

> ***Stand initiation:*** One canopy stratum of seedlings and saplings is present; grasses, forbs, and shrubs typically coexist with the trees.
>
> ***Stem exclusion:*** One canopy stratum comprised mostly of pole-sized trees (5-8.9″ in diameter) is present. The canopy layer may be open (*stem exclusion open canopy*) on sites where moisture is limiting, or closed (*stem exclusion closed canopy*) on sites where light is a limiting resource.
>
> ***Understory reinitiation:*** Two canopy strata are present the size class of the uppermost stratum is typically small trees (9-20.9″ in diameter). In this stage, a second tree layer is established under an older overstory. Overstory mortality created growing space for the establishment of understory trees.
>
> ***Old forest:*** A predominance of large trees (> 21″ in diameter) is present in a stand with one or more canopy strata. On warm dry sites with frequent, low-intensity fires, a single stratum may be present (old forest single stratum; OFSS). On cool moist sites without recurring underburns, multi-layer stands with large trees in the uppermost stratum may be present (old forest multi strata; OFMS).

Surface fire: See: *fire*.

Susceptibility: This term refers to the probability of an organism being infected or infested by another organism (trees affected by bark beetles, defoliators, etc.), as evaluated by using inherent or intrinsic forest characteristics (species composition, stand density, etc.). The terms susceptibility and hazard are often used interchangeably. Compare with: *vulnerability*.

Sustainability: The capacity of forests, ranging from stands to ecoregions, to maintain their health, productivity, diversity, and overall integrity, in the long run, and in the context of human activity and use (Helms 1998).

Sustainable forest management: Active "management that maintains and enhances the long-term health of forest ecosystems for the benefit of all living things while providing environmental, economic, social, and cultural opportunities for present and future generations" (Canadian Council of Forest Ministers 2008).

Thinning: A treatment designed to reduce tree density and thereby improve growth of the residual trees, enhance forest health, or recover potential mortality resulting from intertree competition. Two types of thinning are recognized – commercial thinning where the trees being removed are large enough to have economic value, and noncommercial thinning where trees are too small to be sold for conventional wood products, so the excess trees are cut and generally left on-site (Powell et al. 2001).

Timber harvest: The removal of trees for wood fiber use and other multiple-use purposes (USDA Forest Service 2012a).

Timber production: The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use (USDA Forest Service 2012a).

Tolerance: A forestry term expressing the relative ability of a plant (tree) to complete its life history, from seedling to adult, under the cover of a forest canopy and while experiencing competition with other plants (Harlow et al. 1996). In general ecology usage, tolerance refers to the capacity of an organism or biological process to subsist under a given set of environmental conditions. Note that the range of conditions under which an organism can subsist, representing its limits of tolerance, is termed its ecological amplitude (Helms 1998).

Traditional ecological knowledge: See: *native knowledge*.

Undergrowth: Herbaceous and shrubby plants growing beneath a forest canopy; as used in this report, undergrowth does not include small trees such as seedlings or saplings. Compare with: *understory*.

Understory: All of the vegetation growing under a forest overstory. In some applications, understory is only considered to be small trees (e.g., in a forest comprised of multiple canopy layers, the taller trees form the overstory, the shorter trees the understory); in other instances, understory is assumed to include herbaceous and shrubby plants in addition to trees. When understory is assumed to refer to trees only, other plants (herbs and shrubs) are often called an undergrowth to differentiate between the two (Helms 1998). Compare with: *undergrowth*.

Uneven-aged stand: A stand structure featuring trees of three or more distinct age classes (cohorts), occurring either as an intimate (intermingled) mixture or in small groups (Helms 1998). Reconstruction of historical stand structure for dry-forest sites suggests that these stands were typically uneven-aged, when evaluated at the stand level, but they tended to occur as assemblages of small, even-aged groups or clumps, with each group or clump generally occupying 0.6 acres or less (Powell 2014a).

Upland: Land that generally has a higher elevation than an adjacent alluvial plain, stream terrace, or riparian zone; or land above the foothill zone for a mountainous continuum (Dunster and Dunster 1996). For the Kahler planning area, most of the silvicultural activities are proposed for implementation on upland sites.

Upland forest: A physiognomic class supporting a forest ecosystem, and occurring on upland landforms or biophysical environments (Powell et al. 2007). See: *upland*; *forest*. Compare with: *riparian forest*.

Variable density thinning (VDT): Variable-density thinning approaches are designed to emulate the natural variation resulting from small-scale canopy disturbances and competition-based tree mortality. VDT prescriptions often provide for unthinned areas (skips) and heavily-thinned patches (gaps), with intermediate levels of residual tree density prescribed for the remainder of the stand. This approach results in much greater spatial variability, structural complexity, and heterogeneity than is produced by typical intermediate stand treatments (Franklin et al. 2007).

Vulnerability: This term refers to the probability of tree or forest damage resulting from an infection or infestation by damaging agents (such as bark beetles, defoliators, etc.). Susceptibility reflects the influence of forest or stand conditions (are lodgepole pines in a stand larger than 9 inches in diameter, which renders them susceptible to bark-beetle attack?), whereas vulnerability relates to whether damage will actually occur (is a mountain pine beetle population in close proximity to a lodgepole pine forest containing susceptible trees?).

Watershed: A region or land area drained by a single stream, river, or drainage network; a drainage basin (USDA Forest Service 2012a).

Wildfire: Any fire occurring on wildlands that is not meeting management objectives and thus merits a fire suppression response (Brenner 1998).

Wildland-urban interface: Areas where human communities are built in proximity to flammable fuels found in wildlands (Brenner 1998).

Wood decay: The decomposition of wood by fungi and other microorganisms, resulting in softening, progressive loss of strength and weight, and often changes in texture and color (Helms 1998). Terms associated with wood decay are provided below (unless noted otherwise, term definitions provided by the USDA Forest Service, Forest Products Laboratory).

Bluestain: A deep-seated fungal discoloration, predominantly bluish in color but sometimes grey, black or brown, confined mostly to the sapwood. Bluestain does not cause a loss of structural strength (Doliner and Borden 1984).

Brown rot: In wood, any decay in which the fungal attack concentrates on the cellulose and associated carbohydrates rather than on the lignin, which produces a light to dark brown friable residue known variously as ‘dry rot’ or ‘cubical rot’.

Heart rot: Any rot or decay characteristically confined to the heartwood portion of a tree. Heart rot generally originates in the living tree (such as rust-red stringy rot caused by the Indian paint fungus).

Incipient decay: An early stage of tree decay that has not proceeded far enough to soften or otherwise perceptibly impair the hardness of wood. It is usually accompanied by a slight discoloration or bleaching of wood tissue.

White rot: In wood, any decay or rot attacking both the cellulose and the lignin, producing a generally whitish residue that may be spongy or stringy rot, or occur as pocket rot (advanced decay appearing in the form of a hole or pocket). White rot tends to produce more complete decomposition of the wood, and its decay products are much shorter lived (in the soil) than decay products produced by brown rots.

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Appendix M
Wildlife Report

Terrestrial Wildlife Specialist's Report and Biological Evaluation

Kahler Dry Forest Restoration Project

Umatilla National Forest
Heppner Ranger District

Wheeler and Grant County, Oregon

Prepared by: ______________________________ ______________
Randy Scarlett, Zone Wildlife Biologist Date

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Wildlife

REGULATORY FRAMEWORK

The following laws apply to the Kahler Dry Forest Restoration Project: Endangered Species Act, Migratory Bird Treaty Act, National Forest Management Act, and the Bald and Golden Eagle Protection Act. Additional policy direction relating to wildlife habitat and species is provided in the Umatilla National Forest Land and Resource Management Plan, the Forest Service Manual (FSM 2670), and Executive Order 13186. The Umatilla National Forest Land and Resource Management Plan (LRMP, USDA 1990) contains Standards and Guidelines that must be met for specific Management Areas and wildlife habitats. The Regional Forester's Eastside Forest Plans Amendment #2 (USDA 1995) and other direction amends some of the standards contained in the LRMP and establishes standards for old growth habitat, snag and downed wood densities, and habitat connectivity. The standards and guidelines in the LRMP, as amended, apply to the proposed activities contained in this analysis.

ANALYSIS METHODS

The quantity and quality of wildlife habitat and the effects of the proposed activities on these habitats were assessed using:

- Notes, summaries, and other documents generated from field reconnaissance of the project area in 2012, 2013, and 2014.
- Aerial photos
- Covers, data tables, graphics, maps and other information within and/or generated from information stored within the corporate Geographic Information System (GIS) database on the Heppner Ranger District and Umatilla National Forest.
- Data from current vegetation survey (CVS) plots was used to generate average snag and downed wood densities for the Kahler analysis area. In addition to CVS plot data, Forest Inventory and Analysis (FIA) plots (periodic and annual) were also utilized to estimate snag densities and distribution for the analysis area. A process called Gradient Nearest Neighbor (GNN) was used to produce snag and downed wood density distribution data. GNN is an imputation modeling technique that produces maps where each pixel is associated with the inventory plot (CVS, FIA) that has the most similar spectral and environmental characteristics. These analyses are valid at the large scale (regional, watershed); they are not valid for small scale analysis and specific sites (Ohmann and Gregory 2002). Snag data was classified into two diameter groups: ≥10 inches and ≥20 inches. Survey plots were grouped by DecAID habitat type for the snag distribution analysis. CVS data (266 dry and 27 moist plots) was extrapolated to a per acre measure for downed wood (≥12 inches) and snags (≥10 inches and ≥20 inches).
- The Forest Vegetation Simulator (version 3853, Blue Mountains variant) was used to model stand development for a subset of proposed units in the Kahler project area. Stand exams were conducted in some stands to provide the basis for modeling. For those stands where exams did not occur, data from reference stands that were most similar was imputed using a nearest neighbor methodology. Snag transects were also completed in approximately 25 proposed units in representative areas to provide comprehensive dead wood to validate stand exams and imputed data. The FVS incorporates vegetative data and snag data to grow stands into the future. In the case of Kahler, the stands were grown out 100 years into the future. Refer to the *MIS: Primary Cavity Excavator* Section for a description of these models, including methodology, assumptions, and model outputs.

- NRIS WILDLIFE database and Heppner Ranger District Wildlife Database (sighting reports), including past forest carnivore surveys (surveys were carried out in the winter from snowmobiles on designated routes. All tracks encountered were identified to species and recorded; 1991-1994 and 2010) and peregrine falcon surveys (aerial and land surveys of potential nesting cliffs, surveyed in early 1990's).
- Goshawk surveys completed in May and June 2013. Aerial photos, GIS database, and field reconnaissance were used to identify survey sites within the analysis area.
- DecAID Advisor.
- Vegetative information provided by the District Silviculturist (personal communications, specialist report, and the vegetation database). This information represents the best available information regarding existing vegetation (structure, composition, density, and other features) in the Kahler analysis area.
- The vegetation database for the Kahler planning area was used to assess the current condition and potential effects to elk habitat in the E1 management area. In the C3 management area, the vegetation database for the Kahler planning area was appended with vegetation data for the remainder of the Monument Winter Range, which extends well outside the Kahler planning area, for purposes of running the Habitat Effectiveness Index (HEI) model. In both cases, data was examined and updated where needed based on observations made in the field and through aerial photo interpretation to provide the best possible baseline information for the analysis of elk habitat in the Kahler planning area.
- Publications, reports, scientific papers and personal communications. Those utilized are documented and cited within this wildlife report, as well as the EA.

Where quantitative information is available, it is presented.

SCALE OF ANALYSIS

The scale of the analysis differs based on the species and habitats being considered. For this evaluation and analysis, the term "analysis area" generally (see exceptions below for snag/Primary Cavity Excavator and downed wood sections) refers to Umatilla National Forest lands within the Alder Creek, Lower Kahler Creek, Upper Kahler Creek, Haystack Creek, and Bologna Canyon subwatersheds, an area of approximately 32,850 acres. "Project area" refers to all the affected areas where the proposed project would occur on the landscape. "Affected area" is the stand or portion of a stand (unit) where a specific action or activity would occur. Unless noted, the scale of analysis for direct and indirect effects and cumulative effects is the same. Temporal bounding of cumulative effects generally extends into the past 40 years, although activities occurring even further in the past that are still having residual impacts today are also considered in the cumulative effects analyses, where applicable. Accurate information regarding harvest activities and other ground disturbing activities is generally available from this point forward. The scale of analysis for assessing impacts to wildlife species and habitats will be as follows:

- Late and old structure, old growth habitat, and habitat connectivity are assessed at the scale of National Forest System lands within the five subwatersheds that lie within the Kahler Creek-John Day River watershed, with consideration given to the connectivity of late and old structure habitat and old growth to habitats outside the boundaries of the analysis area. The analysis area for the HRV analysis includes approximately 26,980 acres of National Forest System lands in the immediate vicinity of the Kahler project area.

- Snags are assessed at the scale of the Kahler Creek-John Day River, Upper Rock Creek, and Wall Creek watersheds, combined (approximately 503,281 acres, of which approximately 142,239 acres occur on National Forest System lands) for the Ponderosa Pine/Douglas-fir and Eastside Mixed Conifer-Eastern Cascade/Blue Mountains DecAID habitat types. The analysis area included these three watersheds in order to meet size and composition requirements for the DecAID Advisor. Expanding to this size provided sufficient acres in each DecAID habitat type for a valid dead wood analysis. These features are also assessed at the scale of individual treatment units. The primary cavity excavator group (a Management Indicator Species on the Umatilla) is also assessed at this scale. The viability of this group is assessed at the Forest scale.
- Downed wood is assessed at the scale of the Kahler Creek-John Day River, Upper Rock Creek, and Wall Creek watersheds for the dry upland and moist upland forest Potential Vegetation Groups (PVGs). These features are also assessed at the scale of individual treatment units within the project area.
- The scale of analysis for the Rocky Mountain elk varies depending on standards and direction given by the Forest Plan. In the E1 Management Area, the scale of analysis is the management area allocation lying within each subwatershed represented within the project area (where treatment activities occur). For the C3 management area, the analysis area is all NFS lands within each individual winter range. The minimum analysis area size is 5,000 acres. Viability of this species is assessed at the Forest scale. Refer to the Rocky Mountain Elk section for further clarification, as E1 acres in adjacent subwatersheds were combined because minimum standards (acreage) for running the Habitat Effectiveness Index Model could not be met in individual subwatersheds. The Kahler Basin Winter Range was also too small for a valid HEI run; it was combined with the Monument Winter Range in order to calculate HEI for the C3 Management Area.
- Potential effects on the pileated woodpecker are assessed at the scale of National Forest System lands within the watershed and the larger dead wood analysis area, with respect to source habitat and snag habitat, respectively. Viability of this species is assessed at the Forest scale.
- The American marten is assessed at the scale of National Forest System lands within the watershed, with respect to potential effects to source habitat. Viability of this species is assessed at the Forest scale.
- The scale of analysis for Endangered, Threatened, and Sensitive species, including the Columbia spotted frog, Johnson's hairstreak butterfly, intermountain sulphur butterfly, Lewis' woodpecker, white-headed woodpecker, and gray wolf, is National Forest System lands within the Kahler Creek-John Day River watershed.
- The scale of analysis for the northern goshawk is National Forest System lands within the watershed.
- Neotropical Migratory Birds are assessed at the scale of National Forest System lands within the watershed; specific habitat types and features are addressed at this scale.

Suitable/source habitat for species included in this wildlife analysis was identified during field reconnaissance and by using the vegetation database for the Heppner Ranger District. Vegetation data was queried based on habitat requirements and preferences of selected species, based on the best information available. Suitable habitat queried from GIS was then intersected with proposed treatment units in the Kahler project area. Queries used to identify potential wildlife habitats are available in the Kahler project file at the Heppner Ranger District office. For the purposes of this report, the short term would include immediate impacts and those that last up to 5 years from implementation. The mid-term would include impacts lasting from 5 to 15 years; the long term would apply to impacts that occur or changes that develop in 15 years or longer.

DEDICATED OLD GROWTH HABITAT

AFFECTED ENVIRONMENT

Old growth units are identified in the Forest Plan as Management Area C1 (Dedicated Old Growth - DOG) and Management Area C2 (Managed Old Growth). The goal of this management area is to protect sufficient suitable habitat for wildlife species dependent upon mature and/or overmature forest stands, and promote a diversity of vegetative conditions for such species (USDA 1990, pg 4-144). Unit size and distribution are variable and depend on the vegetation type and the Management Indicator Species (MIS) for which the unit was designated. Old growth units were initially classified as suitable and/or capable habitat for a selected Forest indicator species (pileated woodpecker or American marten in the case of C1; American three-toed woodpecker for C2). For pileated woodpecker, minimum unit size is generally 300 acres; for American marten, 160 acres; and 75 acres for American three-toed woodpecker. Units can occur in smaller (50 acre minimum) blocks no more than ¼ mile apart. Timber management and harvest activities are generally not permitted in the C1 management area; salvage of dead wood is permitted if old growth units are lost as a result of a catastrophic event. Reconstruction and construction of new roads and trails is permitted in the C1 management area, but would be limited to the number and miles necessary to meet surrounding area objectives.

There are no C2 old growth habitat units within the analysis area. There are all or portions of 5 C1 stands within the Kahler Analysis Area. The Umatilla National Forest Land and Resource Management Plan (USDA 1990, pg. 4-56) provides standards and guidelines for the size and spacing of Dedicated Old Growth stands. In general, Dedicated Old Growth in the Kahler area is comprised of ponderosa pine and Douglas-fir; pockets of dense grand fir are present in some areas. DOG unit 1871 burned at high severity in the Wheeler Point Fire in 1996. As it was lost to a catastrophic disturbance event, it was subsequently salvaged and a replacement old growth unit identified. The Forest Plan was amended to move the replacement from the E1 to the C1 management area. This replacement old growth unit (DOG 1971) is approximately 309 acres, of which 214 acres is within the Kahler project area. These C1 old growth units total approximately 1,616 acres. All of these stands would be considered suitable or capable pileated woodpecker habitat, with the exception of the stand that burned in the Wheeler Point Fire. As a result of multiple factors including wild fire, past harvest, and the natural growing potential of dry upland forest, the landscape in the vicinity of the DOGs within the Kahler analysis area is fragmented, and contributes to generally poor old growth connectivity in portions of the analysis area. Under the Kahler EA, vegetative treatment is proposed in DOG 1841 adjacent to Tamarack Lookout to protect infrastructure at the site (lookout, communication equipment, and Tamarack Cabin) from wildfire and other disturbance, and to clear/improve sight lines from the lookout that are currently blocked by overstory vegetation. The 3 acres (of which less than one acre is within the C1) immediately adjacent to the tower would be very open after treatment; the remaining 11 acres lying within the existing C1 stand would be thinned to a lesser degree, with emphasis on clearing sight lines. Some trees >21 inches dbh may be topped to clear sight lines from the tower. As it would be desirable to maintain the area adjacent to the lookout to reduce the risk of damage by disturbance and retain clear sight lines, a replacement for these acres is proposed north of the existing old growth stand. This replacement would be 16 acres in size, would be connected to the existing old growth area, and would provide similar habitat as those acres that would move from the C1 to the E1 management area allocation. A Forest Plan amendment would be required to move these acres into the C1 management area allocation and move 12 acres of existing C1 into the E1 management area allocation. Old growth habitat surveys were conducted in the replacement area on July 8, 2014.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

In the short term, the structure and composition of existing C1 old growth would be maintained. In the mid and long term, shade tolerant conifers would continue to invade these stands, and would compete with ponderosa pine for resources. As understory trees grow that would normally be thinned by fire, they would maintain or move stands toward a multi-strata condition. Perpetuating this conversion to multi-layered old growth conditions would benefit species such as the pileated woodpecker and Williamson's sapsucker. These stands would become increasingly susceptible to insect and disease outbreaks and high-severity wildfire. Under this alternative, there would be a greater risk of passive crown fire and higher flame lengths that could result in larger patches experiencing high severity fire impacts than would have been expected historically. Mixed severity fire enhances habitat for some species while reducing habitat for others. Species that require large patches of live, old forest would be affected where larger patches or more continuous high severity fire occur. Species associated with post-burn habitats (such as Lewis', three-toed, and black-backed woodpecker) would benefit. Infrastructure at the Tamarack site may also be impacted by an uncharacteristically severe wildfire.

Common to All Action Alternatives

Direct and Indirect Effects

Under Alternatives 2, 3, and 4, approximately 12 acres of existing C1 immediately adjacent to the Tamarack administrative site would move into the E1 management area. Approximately 16 acres in the stand immediately north of the existing old growth unit would move from the E1 management area to the C1 management area designation. The Forest Plan would be amended to reflect these changes. There would be a net increase of 4 acres of C1 old growth under these alternatives. The acres that would move into the E1 management area allocation are similar in structure and composition to those that would become C1. At the scale of the Forest, the dedicated old growth network (size/amount and distribution) would be maintained under these alternatives. As a result, this project, as amended, would be consistent with Forest Plan direction and guidance for the C1 management area.

Landscape underburning would not change the overstory tree composition or stand structure in Dedicated Old Growth habitat because prescribed fire would be low intensity. It is expected that prescribed burning would result in some level of mortality of green trees. Elsewhere in the Blue Mountains, research has found that immediate and delayed mortality occurred in 14% of all live trees and up to 5% of all large diameter live trees (>21 inches dbh) following underburning (Thies et al. 2008). Fire-caused mortality would improve snag and downed wood habitat in the short and mid term. While there is a potential for large-diameter snags and downed wood to be consumed during burning (especially those in later stages of decay), these potential impacts are not quantifiable due to the many variables involved. Burning conditions (weather, fuel conditions, and general oversight of burning operations) would be such as to minimize the risk of losing larger-diameter green trees, logs, and snags. Burns would be designed and implemented such that Forest Plan standards for snags and downed wood would be met in burned C1 habitat after treatment. Not all acres within burn blocks would be blackened. While it is difficult to accurately assess the actual number of acres that would be blackened, a general estimate would be 70%. Underburning would be consistent with the goals and desired future conditions for the C1 management area.

Cumulative Effects

Past activities, actions, and events in the Kahler analysis area that affected the quality, amount, and distribution of C1 old growth habitat include Forest Plan management area allocation, timber harvest, fire suppression, wildfire, and disease and insect infestations. The Umatilla National Forest Land and Resource Management Plan designated existing C1 Dedicated Old Growth (DOG) stands in 1990. These stands have been protected from extractive activities since this time. Past (and ongoing) fire suppression resulted in in-growth of shade tolerant tree species in dry forest portions of DOG stands 1971, 1871, 1902, 1922, and 1841, resulting in an increase in multi-strata conditions where single-stratum old growth was historically more prevalent. In those portions of these DOG stands composed of moist upland forest, these conditions were perpetuated by fire suppression. Past timber harvest reduced habitat connectivity and reduced the amount of late and old structure habitat available for designation under the Land and Resource Management Plan as C1 old growth. A portion of one DOG lies within a harvested stand, and does not currently provide old growth habitat features desired by old growth-dependent wildlife. Disease and insect infestations have impacted C1 old growth habitat by impacting the composition of these stands. Spruce budworm infestation in the late 1980s and early 1990s caused mortality of Douglas-fir and grand fir in C1 habitat. Snags created by these events are still standing in some cases. Past wildfire also has contributed to the condition of Dedicated Old Growth habitat in the analysis area. DOG 1871 burned at high severity in the Wheeler Point Fire and was subsequently salvage harvested. This stand was replaced with DOG 1971 to the east. DOG 1971 contains some non-capable habitat and is smaller in size than DOG 1871 was; while DOG 1871 still exists currently in the GIS database, it was removed from the C1 management area in 1996 by a Forest Plan amendment associated with the Wheeler Point Salvage EA. There are no ongoing or reasonably foreseeable future activities that would occur within C1 habitat within the project area.

When the expected effects of the Forest Plan amendment to swap C1 acres immediately adjacent to Tamarack Lookout with acres to the north that share a coincident boundary with DOG 1841 and burning are combined with the residual and expected effects of past, present, and reasonably foreseeable future activities, actions, and events in the analysis area, there would be no cumulative reduction in the quality of C1 old growth habitat in the project area. Underburns would be low intensity ground fires; impacts to overstory vegetation, large snags, and large downed wood would not be quantifiable. Acres that would move into the C1 Management Area would be similar in structure and composition to those that would pass out of the C1 designation. There would be a small net increase (+ 4 acres) in C1 habitat under Alternatives 2, 3, and 4. These new C1 acres would be less likely to be affected by illegal woodcutting (which currently occurs adjacent to Tamarack Lookout) due to the fact that they are distant from an open road.

LATE AND OLD STRUCTURAL STAGES

AFFECTED ENVIRONMENT

The wildlife standards in the Regional Forester's Forest Plan Amendment #2 (USDA 1995) require the evaluation of late and old structural stages relative to the quantity of late and old structural stages that occurred on the landscape historically. For the purpose of this standard, late and old structural stages include old forest multi-strata (OFMS) and old forest single-stratum (OFSS) stands. While only structure is considered here for the purposes of identifying late and old structure habitat, a number of other factors actually affect the quality and effectiveness of these stands for providing habitat to late and old structure associated wildlife species. These factors include large diameter tress, large diameter snags and downed wood, stand complexity/heterogeneity, and trees with broken tops, decay/hollows (resulting from disease or other factors), wind/ice/fire damage, mistletoe brooms, and other features indicative of decadence. A number of species present on the Umatilla National Forest require late and old structure habitat. These species include pileated woodpecker, white-headed woodpecker, Lewis' woodpecker, pine marten, northern goshawk, Cooper's hawk, sharp-shinned hawk, flammulated owl, great gray owl, Vaux's swift, Townsend's warbler, Hammond's flycatcher, and others.

The historical range of variability (HRV) and existing old forest habitat in each potential vegetation group (PVG) in the Kahler project area is shown on Table W-01. The appropriate analysis area size for an analysis of the HRV is 15,000 to 35,000 acres, although areas larger than 35,000 acres are appropriate and preferable for the HRV analysis (refer to Silviculture Specialist Report). The analysis area for the HRV analysis includes approximately 26,980 acres of NFS lands in the Kahler project area. Analysis of spatial vegetation data in GIS was used to identify the current extent of various structural stages (classified by Potential Vegetation Group - PVG) in the analysis area. The HRV analysis (refer to Silviculture Specialist Report) indicates that within the dry upland forest potential vegetation group, the Kahler project area is currently well below HRV for the OFSS structural class and above HRV for the OFMS structural class.

Table W-01. Historic range of variability (HRV) analysis for late and old forest structural classes in the Kahler Project area (see Silviculture Report).

Potential Vegetation Group	Old Forest Multi Strata		Old Forest Single Stratum		NFS Acres (Total)
	Historic Range	Current	Historic Range	Current	
Dry	5-15%	9%	40-60%	5%	26,980

Dark gray in Table W-01 indicates a structural stage and potential vegetation group currently below HRV.

The HRV analysis for this project indicates that the dry upland forest habitat type would all fall into Scenario A of the Eastside Screens (Regional Forester's Forest Plan Amendment #2, USDA 1995). The Screens state that there should be no net loss of old forest habitat from these potential vegetation groups. The Regional Forester's Forest Plan Amendment #2 states that harvest is allowed in LOS stages that are above or within HRV in order to maintain or enhance late and old structure habitat within a particular biophysical environment or to move one type of LOS habitat into an LOS stage that is deficit (below HRV). The analysis area used in this Wildlife Specialist's Report for late and old structure habitat includes all Umatilla National Forest lands within the Alder Creek, Lower Kahler Creek, Upper Kahler Creek, Haystack Creek, and Bologna Canyon subwatersheds, an area of approximately 32,850 acres. Currently, there are approximately 4,130 acres of late and old structure habitat within the Kahler analysis area (Silviculture Report).

Table W-02. Existing condition of late and old structure habitat in the Kahler LOS analysis area.

LOS Structure Type	Existing Habitat (Acres)
Old Forest Single Stratum	1,550
Old Forest Multi-Strata	2,580
TOTAL LOS HABITAT	4,130

These acres were queried from the GIS database using stand structure (old forest single-stratum and old forest multi-strata) to identify late and old structure stands.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

Alternative 1 - No Action

Direct and Indirect Effects

In the short term, late and old structure habitat would maintain its current quality and extent in the analysis area. As a result, single-layer old forest would remain below the historical range of variability in the dry upland PVG. Old forest multi-strata stands would continue to be above HRV in the dry upland forest PVG. Indirectly, the amount of late and old structure would change over time. With the existing management direction, including fire suppression, late and old structure stands (multi- and single-stratum) in the project area would continue to grow into a multistory structure. As understory trees grow that would normally be thinned by fire, they would create a multi-strata canopy where open, single-stratum forest once existed, further reducing single stratum old forest habitat in the dry upland forest PVG. Perpetuating this conversion to multi-layered conditions would benefit species such as the pileated woodpecker and Williamson's sapsucker. These stands would become increasingly susceptible to insect and disease outbreaks and high-severity wildfire. Under this alternative, there would be a greater risk of passive crown fire and higher flame lengths that could result in larger patches experiencing high severity fire impacts than would have been expected historically. Some late and old structure associated species would benefit from this, while others would not. Old forest single-stratum in the dry upland PVG would likely be reduced even further below HRV where passive crown fire and high severity fire becomes more widespread (larger, more continuous patches).

Common to All Action Alternatives

Direct and Indirect Effects

The effects of the three action alternatives would largely be the same; the difference between the alternatives results from varying acres of treatment that would be applied within the project area. Refer to the individual alternative discussions for quantification of these differences. Under all of the action alternatives, there would be no net loss of late and old structure habitat. Under Alternatives 2, 3, and 4, there would be vegetative treatment in Old Forest Single Stratum stands; commercial thinning within these stands would require a Forest Plan amendment to allow these activities. Commercial thinning in these stands has the potential to affect the quality of these stands for late and old structure-associated wildlife species. The "clumpy" nature of OFSS stands may be impacted by commercial thinning; existing clumps of young and mature trees may be thinned to meet basal area targets, which would reduce stand heterogeneity. While trees ≥21 inches dbh (of all species) would not be removed from these stands, young and mature trees less than 21 inches dbh may be removed, reducing the recruitment of trees (and eventually snags) ≥21 inches dbh in the mid and long term. Large snags indicative of old forest conditions and vital to OFSS-associated wildlife species may also be impacted by hazard tree felling in these stands. Under all of the action alternatives, multi-strata late and old structure habitat in the dry upland forest PVG would be commercially thinned with a skip-gap prescription to meet silvicultural and wildlife habitat goals. Treatment would promote increased growth rates in residual trees by reducing competition for resources and resulting stress in dense dry forest stands. Studies show a positive growth response in residual stands following restoration thinning treatments in dry upland forest (ponderosa pine) stands (Kolb et al. 2007, Sala et al. 2005, Skov et al. 2005, Feeney et al. 1998).

Treatment of multi-strata late and old structure habitat (OFMS) would promote the creation or maintenance of single-layered old forest dominated by ponderosa pine, Douglas-fir, and western larch. The oldest trees (including all ponderosa pine and western larch trees greater than 21 inches dbh) in these stands would be retained; smaller, competing understory and overstory trees and those uncharacteristic of the potential vegetation group would be removed. Under Alternatives 2 and 3, this may include some Douglas-fir and white fir that exceed 21 inches dbh that are less than 150 years old, based on visual assessment procedures described in the Silviculture Report and the marking guides for the Kahler Project. Design criteria would be applied under these alternatives to ensure that a portion of these trees are retained as large standing or downed woody structure for wildlife benefit; the District wildlife biologist would be consulted regarding the disposition of these structures. Species adapted to late and old structure, single-strata ponderosa pine stands (e.g., white-headed woodpecker, flammulated owl, Lewis' woodpecker) would benefit in the mid and long term through the restoration of appropriate structural stages and species compositions. Maintenance of skips (up to 15% of unit acres) would maintain potential foraging habitat in close proximity to potential white-headed woodpecker nesting habitat. Reductions in canopy closure, canopy layers, and shade-tolerant tree species would reduce habitat for multi-strata adapted species currently using these habitats, which includes the pileated woodpecker. At the unit scale, skips would provide small patches of dense dry forest habitat that may be utilized by dense-forest associated species for some aspects of their life history. Treatment in dry forest multi-stratum old forest stands would increase the proportion of old forest single-strata habitat within the Kahler planning area under all of the action alternatives. Refer to individual alternative discussions for these changes.

Snags would not be felled in any proposed treatment units unless they pose a safety hazard. For this reason, snags would be retained to the greatest extent possible. The impact of hazard and danger tree felling on late and old structure habitat quality would therefore be minimal. If felled within treatment units, they would be left within units to provide downed woody debris (see Project Design Criteria, EA Chapter 2). The District wildlife biologist would be consulted regarding the disposition of felled hazard and danger trees. Snags and downed dead wood would not be impacted in non-commercial thinning units.

Burning would occur within LOS habitat within and outside treatment units under all of the action alternatives. The entire analysis area would be burned. Burning would largely be restricted to the dry upland forest PVG, where fire historically contributed to the structure and composition of habitat. Pockets of moist and cold upland forest lying within the analysis area would also be underburned. Landscape underburning (including burning in activity units) would not change the overstory tree composition or stand structure on affected acres because prescribed fire would be low intensity (Harrod et al. 2009). While there is a potential for mortality of individual green overstory trees, and large-diameter snags and downed wood to be consumed during burning (especially those in later stages of decay), these potential impacts are not quantifiable due to the many variables involved. New snags created by burning would partially compensate for those lost. Burning conditions (weather, fuel conditions, and general oversight of burning operations) would minimize the risk of losing larger-diameter green trees, logs, and snags. Design criteria would also be implemented to minimize the loss of large, old trees that are retained. Burns would be designed and implemented such that Forest Plan standards for snags and downed wood would be met in all treated LOS habitat, where pre-burn densities exceed the minimum Forest Plan standards. Not all acres within burn blocks would be blackened. While it is difficult to accurately assess the proportion of acres that would be blackened, a general estimate would be 70%.

Non-commercial thinning and temporary road construction would not impact the structure or composition of existing late and old structure habitat under any of the action alternatives. The majority of temporary roads would use existing non-system roadbeds. Where new temporary road construction occurs, existing openings would be followed where available. The width of proposed temporary roads (approximately 15 feet wide) would minimize impacts to overstory vegetation. The structure and composition of late and old structure stands would not be affected by temporary road construction and use.

Cumulative Effects

Past activities, actions, and events in the Kahler analysis area that affected the quality, amount, and distribution of late and old structure habitat include fire suppression, commercial timber harvest (commercial thinning, overstory removal, and regeneration harvest), wildfire (Wheeler Point), disease and insect infestations, and firewood cutting. Past (and ongoing) fire suppression resulted in in-growth of shade tolerant tree species in dry forest stands, resulting in an increase in old-forest multi-strata (OFMS) stands and a reduction in old forest single-stratum (OFSS) habitat. Past commercial thinning and regeneration harvest affected the structure, composition, and distribution of late and old structure stands. The amount of LOS affected by past timber harvest could not be queried from the GIS database because pre-harvest stand data is not available. Since 1975, there have been 9,640 acres of commercial thinning, 4,084 acres of regeneration harvest, and 4,826 acres of overstory removal in the analysis area. Within harvested stands, large trees were targeted for removal; snags and downed wood (density and average size) were also reduced in these stands. Commercial and regeneration harvest reduced connectivity of late and old structure habitats, causing fragmentation of late and old structure wildlife habitat that was historically large and relatively homogeneous. These impacts are still evident on the landscape currently. Wildfire has also affected late and old structure habitat in the analysis area. The Wheeler Point Fire (2006) burned approximately 6,540 acres within the analysis area, with a portion occurring in late and old structure habitat. The majority of the burned acres on NFS lands do not provide a structure and composition suitable for late and old structure-associated wildlife that require high stand densities and multiple canopy layers. Disease and insect infestations have impacted late and old structure habitat in the analysis area to a small degree. These events have primarily impacted pockets of moist upland forest and overstocked dry forest stands. These events have resulted in fragmentation of late and old structure habitat. Conversely, these events created excellent foraging habitat for some late and old structure-associated species (including black-backed and pileated woodpecker) by creating large numbers of large-diameter snags in understory reinitiation and old forest stands. Firewood cutting also reduced the standing dead wood component in late and old structure stands. This activity occurs adjacent to open roads within the analysis area. Snag densities adjacent to open roads have been reduced through this activity. These activities and events have contributed to the existing condition of late and old structure habitat in the analysis area.

Present and reasonably foreseeable future activities, actions, and events that affect late and old structure habitat include firewood cutting and fire suppression. These activities would have the same effects as those described under the past activities section.

When the expected effects of these alternatives are combined with the residual and expected effects of past, present, and reasonably foreseeable future activities, actions, and events in the analysis area, there would be no cumulative reduction of late and old structure habitat in the analysis area. All of the action alternatives would contribute to cumulative effects in old forest stands by reducing canopy closure and structural complexity; this would positively impact some species while negatively impacting others. Thinning of OFMS habitat to restore or move stands towards an OFSS structural condition would begin to reverse the impacts of past management activities and fire suppression in the dry upland forest potential vegetation group. Moving OFSS toward the levels identified in the HRV would benefit those species dependent on these habitats, particularly the white-headed woodpecker, flammulated owl, and Lewis' woodpecker. Treatment of stands currently in an OFSS structural condition has the potential to cumulatively impact the quality of these stands. Desired features, including snags, tree clumps, medium-sized ponderosa pine, and others may be reduced by these activities. The negative effects of reduced structural complexity (canopy layers, understory vegetation, felling of snags that are a hazard) could result in reduced use of affected OFMS habitat by some species, including the pileated woodpecker.

Alternative 2

Direct and Indirect Effects

The effects under this alternative would be similar to those described under *Common to All Action Alternatives*. Approximately 1,090 acres of OFSS would be treated under this alternative. Alternative 2 would move 380 acres into a single-stratum old forest (OFSS) structural condition (See Silviculture Report), increasing the proportion of this structure type to 7% (from 5%) in the analysis area in the short term. In the long term (year 2065), the proportion of OFSS in the analysis area is projected to increase to 39% (from the existing of 5%) in response to treatment and future maintenance with prescribed fire. This level is just below the range identified in the HRV. Under this alternative, approximately 1,300 acres of OFMS habitat would be treated, with 380 acres being converted from OFMS to OFSS immediately. The proportion of this structural stage would decrease from 9% to 7% immediately following treatment; this would be within the HRV expected for this structural stage. In the long term the proportion of OFMS in the analysis area is projected to increase to 16% (from the existing of 9%) in response to treatment. This level is just above the range identified in the HRV (5% to 15%) for this structural stage.

Alternative 2 would have a greater impact on habitat used by multi-strata old-growth associated wildlife than the other action alternatives in the short and mid-term since it reduces canopy closure and structural complexity on more acres of dry upland forest OFMS than Alternatives 3 and 4.

Under this alternative, the most acres of late and old structure habitat would be treated. Fuels created by harvest activities (slash) would increase the risk of large diameter green tree, snags, and downed wood being affected during underburns. Because this alternative would treat commercial-sized vegetation on the most acres and create the most slash, it would also have the greatest risk to these features. Project design criteria would be implemented to reduce these risks.

This alternative would be consistent with the Eastside Screens (Scenario A) with regard to late and old structure habitat. Amendment of the Forest Plan to treat vegetation in an LOS stage (OFSS) currently below the HRV would be consistent with Regional and Forest-level direction (USDA 2003).

Cumulative Effects

The cumulative effects under this alternative would be similar to those described under *Common to All Action Alternatives*. When the expected effects of this alternative are combined with the residual and expected effects of past, present, and reasonably foreseeable future activities, actions, and events in the analysis area, there would be no cumulative reduction of late and old structure habitat. This alternative would do the most to reverse the impacts of past fire exclusion and harvest activities in the Kahler analysis area. By treating the most acres of existing OFSS habitat, it would also impact the quality of existing OFSS to a greater degree than would Alternatives 3 and 4. This alternative would also have the most short-term impacts to snags in late and old structure habitat (through hazard and danger tree abatement) when compared to the other action alternatives. This alternative would also have the largest cumulative impact on the complexity of dry multi-strata old forest habitat when compared to Alternatives 3 and 4.

Alternative 3

Direct and Indirect Effects

The effects under this alternative would be similar to those described under *Common to All Action Alternatives*. Alternative 3 would have less short and mid-term impacts on late and old structure habitat and associated wildlife than Alternative 2, due to a slight decrease in the number of acres treated. This alternative would treat approximately 970 acres of OFSS and 1,230 acres of OFMS (120 fewer acres OFSS and 70 fewer acres of OFMS treatment). Conversely, fewer acres would be moved toward a single-stratum late and old structure condition in the dry upland forest PVG under this alternative. Alternative 3 would move 380 acres of multi-strata late and old structure (OFMS) habitat in the dry upland forest PVG into a single-stratum old forest (OFSS) structural condition (See Silviculture Report). At the scale of the Kahler analysis area, these activities would increase the proportion of this structure type to 7% (from 5%) in the analysis area in the short term. In the long term (year 2065), the proportion of OFSS in the analysis area is projected to increase to 37% (from the existing of 5%) in response to treatment and maintenance burning. Under this alternative, approximately 1,230 acres of OFMS habitat would be treated, with 380 acres being converted from OFMS to OFSS immediately. The proportion of this structural stage would decrease from 9% to 7% immediately following treatment; this would be within the HRV expected for this structural stage. In the long term (2065), the proportion of OFMS in the analysis area is projected to increase to 17% (from the existing of 9%) in response to treatment. This level is just above the range identified in the HRV (5% to 15%) for this structural stage.

This alternative would be consistent with the Eastside Screens (Scenario A) with regard to late and old structure habitat. Amendment of the Forest Plan to treat vegetation in an LOS stage (OFSS) currently below the HRV would be consistent with Regional and Forest-level direction (USDA 2003).

Cumulative Effects

The cumulative effects under this alternative would be similar to those described under *Common to All Action Alternatives*. When the expected effects of this alternative are combined with the residual and expected effects of past, present, and reasonably foreseeable future activities, actions, and events in the analysis area, there would be no cumulative reduction of late and old structure habitat within the analysis area. This alternative would have less short-term impacts on the quality of OFSS and OFMS habitat than Alternative 2 due to the fact that fewer acres would be treated. In the long term, fewer acres of dry upland forest OFSS habitat would be restored under this alternative than Alternative 2. For these reasons, this alternative would do slightly less to reverse past losses in single-stratum late and old structure habitat in the dry upland forest PVG than would Alternative 2.

Alternative 4

Direct and Indirect Effects

The effects under this alternative would be similar to those described under *Common to All Action Alternatives*. Alternative 4 would have less short and mid-term impacts on late and old structure habitat and associated wildlife than Alternatives 2 and 3, due to a slight decrease in the number of acres treated. Conversely, fewer acres would be moved toward a single-stratum late and old structure condition in the dry upland forest PVG under this alternative. Alternative 4 would move 380 acres of multi-strata late and old structure (OFMS) habitat in the dry upland forest PVG into a single-stratum old forest (OFSS) structural condition (See Silviculture Report). At the scale of the Kahler analysis area, there would be a slight increase in the proportion of the analysis area (from 5% to 7%) in this structure type in the short term. In the long term (year 2065), the proportion of OFSS in the analysis area is projected to increase to 33% (from the existing of 5%) in response to treatment and maintenance burning. Under this alternative, approximately 1,180 acres of OFMS and 750 acres of OFSS habitat would be treated, with 380 acres being converted from OFMS to OFSS immediately. The proportion of this structural stage would decrease from 9% to 7% immediately following treatment; this would be within the HRV expected for this structural stage. In the long term (2065), the proportion of OFMS in the analysis area is projected to increase to 18% (from the existing of 9%) in response to treatment. This level is just above the range identified in the HRV (5% to 15%) for this structural stage.

This alternative would be consistent with the Eastside Screens (Scenario A) with regard to late and old structure habitat. Amendment of the Forest Plan to treat vegetation in an LOS stage (OFSS) currently below the HRV would be consistent with Regional and Forest-level direction (USDA 2003).

Cumulative Effects

The cumulative effects under this alternative would be similar to those described under *Common to All Action Alternatives*. When the expected effects of this alternative are combined with the residual and expected effects of past, present, and reasonably foreseeable future activities, actions, and events in the analysis area, there would be no cumulative reduction of late and old structure habitat within the analysis area. This alternative would have less short-term impacts on the quality of OFSS and OFMS habitat than Alternatives 2 and 3 due to the fact that fewer acres would be treated. In the long term, fewer acres of dry upland forest OFSS habitat would be restored under this alternative than the other action alternatives. For these reasons, this alternative would do slightly less to reverse past losses in single-stratum late and old structure habitat in the dry upland forest PVG.

CONNECTIVITY

AFFECTED ENVIRONMENT

Wildlife standards in the Regional Forester's Forest Plan Amendment #2 (USDA 1995) require late and old structural stands and designated old growth areas to be connected to each other across the landscape. For this standard, connective habitat does not necessarily need to meet the same description of suitable habitat for a particular species, but provide "free movement" between late and old structural stands and old growth areas for various wildlife species associated with the late and old structural condition. The Regional Forester's Amendment #2 allows for treatment within connectivity habitat as long as certain conditions are met. These conditions include: stands maintain medium and large trees (are "common"), canopy closures are within the upper 1/3 of site potential, connections are at least 400 feet wide (where available), and old growth/LOS are connected in at least two directions. Where these conditions cannot be met, the best available connectivity habitat should be provided.

Connectivity of late and old structure habitat and C1 old growth is poor in portions of the analysis area due to natural openings, vegetative composition, past management activities, and past wildfire. Portions of the analysis area, particularly ridge tops and lower elevation areas, are composed of grasslands and shrublands, including contiguous grasslands, grasslands interspersed with timber, grassy stringers associated with draws, and other non-forest habitat features. As a result, portions of the analysis area have a naturally low potential to provide connectivity to adjacent or distant stands. Connectivity habitat was identified based on stand data (structure, canopy closure, cover type, etc.) in the existing vegetation database. This database was updated with new information gathered in 2013. Stands with the highest canopy closure and complexity were identified to provide the best connections between late and old structure habitat and Forest Plan old growth. Proposed treatment units are present in identified connectivity corridors. Design criteria would be used where proposed units and connectivity corridors overlap to maintain old growth connectivity and to meet the standards provided by the Forest Plan, as amended by the Eastside Screens (USDA 1995).

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

In the short term, late and old structure stands and old growth stands would remain connected across the landscape and within the project area with dense stands composed of medium to large trees, corridor widths greater than 400 feet, and by two or more corridors (where these attributes are available). Indirectly, connectivity habitat would change over time. With the existing management direction including fire suppression, stands in the project area would continue to grow into dense, multi-layered stands, improving the quality of connections for some LOS associated species (e.g., pileated woodpecker). This condition would increase the susceptibility to high-severity wildfire, and insect and disease outbreaks (see discussion in *Dedicated Old Growth* and *Late and Old Structure* sections). Larger patches and more widespread high severity fire would change the composition and structure of connectivity habitat. The connectivity of late and old structure and old growth stands may be reduced to some degree. This may limit the "free movement" of some wildlife species where larger patches of high severity fire cause fragmentation of habitat at the small scale.

Common to All Action Alternatives

Direct and Indirect Effects

Commercial thinning would occur in stands identified as connectivity corridors during project development. Forest Plan standards for connectivity habitat (canopy closure in the upper 1/3 of the site potential, at least two connections, at least 400 feet wide, medium and large trees "common") would be met following implementation, where these attributes are available. As the majority of the analysis area is composed of dry upland forest, the upper 1/3 of the site potential would be relatively low (approximately 25 to 30% canopy cover for ponderosa pine stands). The proposed treatments would move stands towards the historic, more open condition. Design criteria would be implemented that maintain a higher basal area (and therefore canopy cover) or provide a higher proportion of skips (untreated areas) in stands within connectivity corridors than those stands outside connectivity corridors. These corridors would continue to provide connections between late and old structure habitat and Forest Plan old growth habitat and facilitate the movement of wildlife between these habitats following implementation. Noncommercial thinning would have no impact on the quality of connectivity habitat because overstory composition and structure would not be affected. Untreated patches of small-diameter conifers would be maintained in non-commercially thinned units to provide hiding cover for wildlife.

Landscape underburning would not change overstory composition or structure in connectivity habitat or the late and old structure these stands are providing connections between. Burning would reduce a portion of understory vegetation in connectivity habitat; however, patches of unburned understory would be maintained due to the low intensity of underburning. Occasional overstory trees would likely be killed by underburning. Impacts to snags and downed wood are also expected to be minor due to the low intensity of proposed underburns.

Existing roads (open and closed) used for harvest would not change the composition or structure of connective habitat in the project area.

Under all of the action alternatives, there would be one connectivity corridor impacted by new temporary road construction. However, the new temporary road (constructed under Alternatives 2 and 3 only) would be constructed through an opening at the margin of the identified connectivity corridor. There would be no impacts to the quality of the connectivity corridor through construction and decommissioning of this temporary road. There are also three existing temporary roads that would intersect identified connectivity corridors. Two of these are situated in openings or very sparse stands and the third is located in intermingled timber and openings. Where necessary, clearing of vegetation would be required to permit vehicle use. It is not expected that clearing along existing temporary roads (to a maximum of 15 feet wide) would impact the quality of connectivity corridors because these routes exist on the ground currently.

Cumulative Effects

Past activities, actions, and events in the Kahler analysis area that affected the connectivity of late and old structure habitat include fire suppression, commercial timber harvest (regeneration harvest, overstory removals, commercial thinning), wildfire (Wheeler Point), and disease and insect infestations. Past (and ongoing) fire suppression has resulted in in-growth of shade tolerant tree species in dry forest stands, resulting in an increase in old forest multi-strata stands and a reduction in old forest single-stratum habitat. This has resulted in improved connectivity for some multi-strata and dense overstory-associated wildlife. Since 1975, there have been 9,640 acres of commercial thinning, 4,084 acres of regeneration harvest, and 4,826 acres of overstory removal in the analysis area. Data from prior to this time period is unreliable and incomplete. These activities have affected the structure and composition of forested stands. Commercial and regeneration harvest reduced connectivity of late and old structure habitats, causing fragmentation of late and old structure wildlife habitat. These impacts are still evident on the landscape currently. Wildfire has also affected connectivity habitat within the analysis area. The Wheeler Point Fire generally burned at high severity within the analysis area. A large proportion of the acres within this fire no longer provides a structure and composition that would satisfy the connectivity requirements of the Regional Forester's Forest Plan Amendment #2 (Eastside Screens, USDA 1995). Disease and insect infestations have impacted forested stands in the analysis area to a small degree. In general, these events did not result in complete mortality of overstory trees in dense dry upland forest stands; overstory structure was generally maintained on affected acres. These activities and events have combined to create the existing condition of connectivity habitat in the analysis area.

There are no ongoing or reasonably foreseeable future activities, actions, and events that are affecting or would affect connectivity habitat in the analysis area.

When the expected effects of these alternatives are combined with the residual and expected effects of past, present, and future actions in the analysis area, there would be no cumulative reduction in connectivity between late and old structure and Dedicated Old Growth habitats. Connectivity habitat would continue to meet the intent of the amended Forest Plan standards under these alternatives. While the density (canopy cover) of connectivity corridors would be reduced, they would continue to allow for the free movement of wildlife between late and old structure stands and Dedicated Old Growth stands.

SNAG REPLACEMENT TREES

AFFECTED ENVIRONMENT

Snag replacement trees are analyzed to determine the potential for recruitment of dead tree habitat over time across the landscape. Current direction for green tree replacement (GTR) densities are based on the requirements described in the Eastside Screens (USDA 1995), which requires that all sale activities maintain green replacement trees of ≥ 21 inches dbh (or whatever is the representative dbh of the overstory layer if it is less than 21 inches), at 100% potential population levels of primary cavity excavators. For the Heppner Ranger District, GTR density objectives were enumerated in a memo dated April 14, 1993 entitled "Interim snag guidance for salvage operations (USDA 1993). GTR objectives were further clarified on the adjacent North Fork John Day Ranger District in 1996; the GTR values provided in the 1993 memo continue to be the objective (minimum) for the Heppner Ranger District.

Table W-03. Green tree replacement objectives (USDA 1993).

Tree Size (diam. at breast height)	Plant Association			
	Ponderosa Pine	**South Associated**	**North Associated**	**Lodgepole Pine**
10-12 inches	7.5	5.6	1.6	10.1
12-20 inches	13.6	9.1	6.8	4.3
>20 inches	1.7	1.1	1.1	0
*Total (#/acre)	22.8	15.8	9.4	14.4

*Division of GTRs by diameter does not preclude the partial or total substitution of larger green trees for smaller ones, although it is recognized that a distribution of size classes will provide for snag replacement over a greater period of time.

Currently, all of the stands proposed for commercial thinning meet green tree replacement objectives. Burned areas within the analysis area are currently deficient in appropriately sized green tree replacements; however, the majority of burned areas have high densities of small diameter trees that will grow into appropriate size classes and provide for snags in the long term.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

Within the next five years, snag replacement trees (live/green) would continue to occupy the project area at or near current densities and size classes. In the mid and long term (5 to 15+ years), green tree replacements may increase or decrease depending on the events that occur. Green tree replacements would be reduced by disease and insect outbreaks in proposed commercial thinning stands. Disease and insect outbreaks have the potential to affect dense, multi-strata stands. Although green tree replacements may decrease in the future due to mortality, it is unlikely that green tree replacement levels would fall below Forest Plan objectives. Growth and development over time would tend to increase green tree replacements. In the long term, mortality of overstory trees would increase standing and downed fuel loads, increasing the risk of high-severity wildfire. It is expected that mixed severity fire would occur; however, there would be larger patches of high severity impacts due to higher flame lengths and resulting passive crown fire. Larger, more contiguous patches of habitat would experience higher overstory mortality than would have been expected historically. In these patches, it would take in excess of 80-100 years to regain sufficient quantities of replacement trees, in appropriate size classes, to meet the Forest Plan objectives for green tree replacements and Forest Plan standards for snags.

Common to All Action Alternatives

Direct and Indirect Effects

Proposed harvest activities (commercial thinning, shrub-steppe enhancement, and non-commercial thinning) would directly and indirectly affect green trees in the project area. Commercial thinning and shrub-steppe enhancement would reduce the density of green trees in treatment units; however, all treated stands would meet or exceed objectives for green tree replacements (USDA 1996) following treatment, where appropriate. Shrub-steppe enhancement units are located in areas where overstory trees were sparse under the HRV. These stands may be below green tree replacement objectives following implementation due to the fact that this condition would have occurred in these areas historically. Commercially thinned stands would provide densities of green trees that would meet these objectives due to the fact they would be thinned using a basal area objective. Skips within treatment units would provide for high levels of green tree replacements and the potential for endemic or greater snag recruitment. Small diameter conifer thinning (non-commercial thinning) would also reduce stand densities. This activity would affect small diameter green trees that do not currently contribute to green tree replacements because if they were to die, they would be largely unusable to primary cavity excavators. This activity would improve growing conditions for residual trees. While green tree replacement objectives would continue to be met, there would be a reduction in the number of trees available in harvest units for eventual recruitment as snags. Refer to the *Primary Cavity Excavator* section for a description of potential impacts to future snag habitat.

Low-intensity landscape burning would reduce fuels (slash) created from harvest and thinning activities, and reduce understory vegetation. Prescribed fire could cause mortality of small-diameter conifers and an occasional overstory tree; however, overstory composition would generally be unaffected by low-intensity underburning. Green tree replacements would be expected to remain above objectives after landscape burning.

Cumulative Effects

Past activities, actions, and events in the Kahler analysis area that have affected green tree replacements include timber harvest (9,640 acres commercial thinning, 4,084 acres regeneration harvest, and 4,826 acres overstory removal since 1975), wildfire (Wheeler Point), and insect and disease outbreaks. Past harvest activities have directly affected green tree replacements by reducing stand densities. Some of these harvested acres continue to be deficient in green trees and snags due to past harvest methods and the time that has passed since these stands were treated. Past wildfire caused heavy overstory mortality in the western portion of the analysis area, affecting snag dynamics. There is a considerable lag time between when fire-created snags fall and when the regenerating stand contains large enough trees to produce effective snags. Insect outbreaks (spruce budworm) have resulted in varying levels of mortality in grand fir and Douglas-fir in some stands within the analysis area; generally green tree replacements are available in these stands. These activities have combined to create the existing condition of green tree replacements in the analysis area.

There are no ongoing or reasonably foreseeable future activities, actions, and events in the analysis area with a potential to affect green tree replacements.

When the expected effects of these alternatives are combined with the residual effects of past activities, actions, and events, there would be no cumulative increase in acres below green tree replacement objectives.

DOWNED WOOD HABITAT

AFFECTED ENVIRONMENT

The Umatilla Forest Plan (USDA 1990) established standards and guidelines for downed wood for various levels of biological potential in each management area. The plan was amended in 1995 by the Regional Forester's Forest Plan Amendment #2, also known as the "Eastside Screens."

For coarse-scale analysis or when fine-scale data is not available, data from Current Vegetation Survey (CVS) plots can be used to estimate average downed wood densities and analyze effects on downed wood. CVS data will be used in this analysis to estimate downed wood densities at the watershed scale to compare with Forest Plan standards. Current Vegetation Survey inventories are permanent plots on a 1.7-mile grid that sample the vegetative condition across National Forest Lands. Plot data was collected on the Umatilla National Forest between 1993 and 1995 and re-measured on selected plots in 1997, 1999, and 2002. At each plot/point, a variety of vegetative information is collected. Data collected includes plant association, live trees, dead trees, and downed wood, with diameters and heights for each species tallied. Deadwood was tallied for each 2" diameter class in the plot/point then aggregated by potential vegetation group and divided by the number of plot/points to arrive at an average number of deadwood pieces for each size class in a potential vegetation group. Per Forest Plan direction, only downed wood larger than 12 inches in diameter was used to estimate existing downed wood densities in the Dry and Moist Upland Potential Vegetation Groups.

Downed wood density estimates derived from Current Vegetation Survey data are statistically valid at the watershed scale or larger. Current Vegetation Survey estimates of downed wood densities used in this analysis are not statistically valid at smaller scales or for a specific site within the watershed. Snags and downed wood tend to occur on the landscape as singles, groups, clumps, patches or piles resulting from natural tree mortality and disturbances, such as fires, insect and disease, ice storms, and drought. These random events result in an uneven distribution of downed wood across the landscape.

Current Forest Plan direction for downed wood densities is based on the Forest Plan (USDA 1990) and direction given in the Eastside Screens (USDA 1995). The Forest's amended guidelines for downed wood densities for the Kahler analysis area are found in Table W-04. As there are few cold upland forest stands in the Kahler Planning Area, and those that are present generally do not contain a preponderance of Engelmann spruce, subalpine fir, and lodgepole pine, these stands will be considered moist upland forest stands for the purposes of this analysis.

Table W-04. Forest Plan minimum standards and existing downed wood density in the Kahler analysis area (Kahler Creek-John Day River, Upper Rock Creek, and Wall Creek Watersheds).

Forest Plan Standard (amended 1995)		Forest Plan Downed Wood Criteria (minimum)	Kahler Analysis Area (CVS Data)	
Vegetation Type	**Down wood Density**		**Potential Vegetation Group**	**Down wood Density**
Ponderosa pine/Douglas-fir	3-6 pcs/ac	Small end dia. >12 inches Piece length >6 feet Total length 20-40 feet	Dry Upland Forest	18.4 pcs/ac
Mixed conifer/grand fir	15-20 pcs/ac	Small end dia. >12 inches Piece length >6 feet Total length 100-140 feet	Moist Upland Forest	54.9 pcs/ac

When compared to Forest Plan standards (as amended) for downed wood density, current estimates of average downed wood densities exceed the Forest Plan standard for the dry and moist upland forest potential vegetation groups. It should be pointed out that inclusion of the Wall Creek Watershed in the downed wood analysis area resulted in much higher average downed wood densities than those in the Kahler Creek-John Day River and Upper Rock Creek Watersheds. This is likely due to the fact that dry and moist upland stands in portions of the Wall Creek watershed were impacted heavily by spruce budworm in the 1980s and early 1990s, resulting in very high snag densities in these stands. Ongoing fuels treatments under the Wildcat II EA have reduced these snag and dead wood densities, but are not reflected in CVS data; these plots have not been re-measured since fuels treatment began. Within the analysis area, a wide range of downed wood habitat conditions exists; some stands have very little to no wood, while others have levels much greater than the Forest Plan standard.

Effects to downed wood habitat are assessed at the scale of individual treatment units and the entire Kahler analysis area.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

Over the next five years, dead downed wood would continue to occupy the analysis area at or near the current density in the dry upland and moist upland forest potential vegetation groups. Over the next five to fifteen years, falling snags would be the primary factor contributing to the recruitment of downed wood habitat, potentially increasing downed wood densities across the analysis area. In the long term, stands would continue to develop multi-layered conditions, resulting in stress and competition for resources. Potential increases in the incidence of insects and disease would cause mortality in these stands, increasing potential standing and downed wood, and the risk of high-severity wildfire. It is expected that mixed severity fire would occur; however, there would be larger patches of high severity impacts due to higher flame lengths and resulting passive crown fire. Larger, more contiguous patches of habitat would experience high overstory mortality than would have been expected historically. Initially, downed wood would be consumed; it would increase as snags created by firebegin to fall. A mosaic of downed wood conditions would result, with some stands having little downed wood due to repeated disturbance and other having moderate to high levels of downed wood.

Common to All Action Alternatives

Direct and Indirect Effects

Proposed commercial harvest, non-commercial thinning, shrub-steppe enhancement treatments, burning of activity and natural fuels, and temporary road construction under each of the action alternatives would have the same effects on downed wood habitat; the extent of these activities would vary by alternative. Since downed wood would be impacted in proposed treatment units by machinery use, activity fuels treatment (if necessary), landscape underburning, and indirectly through hazard/danger tree felling, it stands to reason that an increase in the acres and miles impacted by these activities would have a greater impact on downed wood.

Proposed commercial and non-commercial thinning and shrub-steppe enhancement treatment would not directly reduce large (>12 inches) downed wood densities because downed wood would not be harvested or removed from treatment units. Where concentrations of small diameter downed wood are present and would increase fire risk to residual vegetation, some small diameter downed wood may be removed. Indirectly, dead wood (>12 inches) may be affected by harvest operations (skidding, skid trails, landings, etc.) in proposed units. Downed wood may be moved, cut into pieces, or broken apart as a result of harvest activities. Downed wood that meets individual size requirements (>12 inches small end diameter and >6 feet long) and overall densities that minimally meet the levels prescribed by the Forest Plan would be maintained in treatment units as singles, groups, and piles, where available. Where no downed wood >12 inches is available, the largest material available would be maintained to meet the intent of the minimum Forest Plan standards. Mechanical activity fuels treatment (mastication), if necessary, would not affect the density of existing downed woody material. Only harvest-created debris would be affected by this activity.

Under all of the action alternatives, approximately 31,000 acres would be burned over a period of

5 to 10 years. For this reason, the impacts associated with burning would be virtually the same for Alternatives 2, 3, and 4; any differences between alternatives are described in individual alternative discussions. Burning treatments have the potential to affect downed wood retained after vegetative treatment. Burning would occur in either the spring or fall. The timing of burning largely depends on burn windows associated with weather and fuel moisture. Fuel moisture and weather would be used to create a low-intensity underburn that would blacken approximately 50% to 75% (average 70%) of burn acres. Wood in later stages of decay and fine woody material would be the most likely to be consumed by burning. The potential for consumption of larger diameter material would be greater during fall burning, when fuel the moisture of downed material is the lowest. Design criteria (PF1, PF2, and PF3) would be implemented to reduce impacts to downed woody material. Underburns would also be expected to create snags within the burn area, partially compensating for wood lost to burning in the short and mid-term. Due to the fact that impacts to downed wood are expected to be relatively minor in commercial thin, shrub-steppe, and non-commercial thin units and consumption of larger diameter downed wood during burning is also expected to be minimal, it is unlikely that wildlife requiring large downed wood would be appreciably impacted. Primarily wood in later stages of decay, and smaller diameter, fine material would be affected by these activities. While charring of downed wood may impact the availability of potential prey (i.e. ants) to some degree, burning would also result in the immediate and delayed mortality of some live trees. Insects would colonize these trees and provide foraging opportunities for some species, particularly insectivorous birds (i.e. woodpeckers and Neotropical migratory birds). Based on research, it is expected that as much as 5% of large trees and 14% of all live trees (Thies et al. 2008) may be killed by prescribed fire. Given design criteria and the structure and composition of post-harvest stands that will be burned, it is expected that mortality in the Kahler area would be less than levels reported by Thies and others (2008).

Danger tree felling along roads used for harvest would also indirectly impact future downed wood densities by removing dead and structurally deficient trees that would be expected to fall to the ground in the short and mid term. It is not expected that this activity would appreciably impact downed wood densities at the analysis area scale due to the amount and location of the areas that would be impacted. The areas affected by this activity would be relatively narrow, and situated along roads, where standing and downed wood densities are generally lower due to firewood cutting and past danger tree abatement activities. Road construction (temporary and new system road) generally would not result in reductions in downed wood. These temporary roads are generally located in existing man-made and natural openings. Downed wood may be crushed or pushed out of the road prism to allow for this activity, but it would not be removed.

The proposed treatment activities would reduce the density of standing green trees, which would in turn reduce stress and resulting density-dependent mortality (insects, disease, etc.). Reductions in these agents would reduce mortality in treated stands, ultimately reducing snag recruitment and downed wood levels. As downed wood habitat was not modeled into the future, the degree to which this would occur is unknown.

Average downed wood densities are expected to meet or exceed Forest Plan standards in the dry upland forest PVG within treatment units under Alternatives 2, 3, and 4 following vegetative treatment and burning. Design element WL1 prescribes higher levels of downed woody material retention than minimum levels provided by the Forest Plan; these levels would be met (where material is available) following implementation.

Cumulative Effects

Past activities and events in the Kahler analysis area that have affected downed wood include insect and disease outbreaks, timber harvest and fuels treatment, wildfire, fire salvage, underburning/site-prep burning, and personal-use firewood collection. Insect outbreaks in the late 1980s and early 1990s have contributed to downed wood densities in portions of the analysis area. Overstory vegetation in portions of the analysis area (primarily overstocked dry upland forest stands and pockets of moist and cold upland forest) was killed by spruce budworm infestations. Downed wood densities well in excess of the Forest Plan standards are available in some areas. Past harvest activities affected downed wood densities by removing or piling and burning dead wood within treatment units prior to the existence of Forest Plan standards. Activity fuels burning after harvest (and other underburning) also impacted downed wood densities to varying degrees. Fuels treatment activities in the Wildcat II planning area have impacted downed wood densities in stands impacted by the spruce budworm in the 1980s and 1990s. Downed wood was removed to decrease risk of high severity wildfire in these stands. Minimum downed wood standards, with an emphasis on retention of large diameter material, are being met in these treatment units. Underburns generally had minor impacts on dead wood densities due to the timing and weather conditions that existed during burning. Wildfire (Wheeler Point, Monument Complex, and Sunflower) within the project area generally consumed downed wood within affected areas, especially small diameter material. While immediate and delayed fire mortality created numerous snags (and eventually downed wood) in the Wheeler Point Fire, the majority of the fire area on NFS lands that was affected by high severity fire was salvaged (2,614 acres). Approximately 250 acres of salvage also occurred in the Monument Fire. Salvage harvest of dead and dying trees impacted future recruitment of downed wood within the fire area and reduced the potential for high density downed wood patches in this portion of the analysis area. The Sunflower Fire (2014) burned approximately 7,200 acres in the analysis area, with the majority burning at a low severity; downed wood recruitment will increase in the years following the fire. Personal use firewood cutting has reduced snag and downed wood densities adjacent to open roads in the analysis area. A reduction in snags adjacent to open roads ultimately reduces future downed wood recruitment. Past activities, actions, and events have combined to create the existing condition of downed wood habitat in the analysis area.

Present and reasonably foreseeable future activities that affect downed wood include firewood cutting, prescribed burning, fuels treatment, and hazard tree salvage within the Sunflower Fire area. The Wildcat II Project would have the same impacts as those described above. While downed wood densities would be reduced, they are expected to meet Forest Plan standards following treatment at both the unit and landscape scales where dead wood is currently available. It is expected that prescribed underburning in the Rim Rock, Sunflower Bacon, and Wildcat II planning areas, as well as the desire to burn the Kahler area on a regular (maintenance) basis, would impact downed wood to some degree, especially in areas where harvest-created slash is present. The burns would largely impact smaller diameter downed wood. Prescribed fires would be timed to create low severity ground fires; as a result, existing larger material would largely be maintained. Firewood cutting impacts future recruitment of downed wood by removing standing dead trees and along roadways. Relatively few snags and downed logs of desirable firewood species are present along some roads in the analysis area due to firewood cutting and the natural growing potential of some areas. Hazard trees would be felled and removed on approximately 196 acres within the Sunflower Fire within 200 feet of selected roads. This activity would reduce future downed wood recruitment on the affected acres.

When the expected effects of these alternatives are combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be an incremental reduction in downed woody material in the project area in the short and mid-term. This would be the result of underburning, hazard/danger tree felling (and removal of those danger trees <20 inches dbh along existing and temporary roads), and reduced recruitment of dead wood following treatment. The impacts associated with the proposed activities are expected to have minor impacts on downed wood habitat. Because snags would be minimally impacted, green tree replacement objectives met, and burning would be low intensity, Forest Plan downed wood standards are expected to be met (where material is currently available and meeting standards) at the stand and landscape scale following treatment. In the long term, the amount and intensity of treatment that would be applied to the Kahler Project area, when combined with future burning in the Kahler area (maintenance burning on a 10 to 15 year rotation), may result in downed wood levels that fall below Forest Plan standards for a time. As snag recruitment increases in the long term, downed wood is also expected to rebound.

Alternative 2

Direct and Indirect Effects

Alternative 2 would mechanically treat the most acres when compared to Alternatives 3 and 4. As a result, the expected impacts to downed wood, although relatively minor in the short and mid term, would be greatest under this alternative. It is expected that Forest Plan minimum standards for downed wood would be met on affected acres after implementation where these standards are currently being met. While small diameter downed wood may be removed in isolated locations to protect residual green vegetation and snags/large downed wood, the largest available would be retained and protected from burning impacts for wildlife use. As discussed under Common to All Alternatives, charring of larger material may occur. It is not expected that species dependent on downed wood for foraging and cover would be adversely impacted by the proposed activities.

Cumulative Effects

The cumulative effects of this alternative would be similar to those described under *Common to All Action Alternatives.* As this alternative would treat the most acres mechanically (ground-based and helicopter with mechanical pre-bunching), it would also have the most short term cumulative impacts on downed wood. Under this alternative, Forest Plan standards would continue to be met or exceeded at the stand and analysis area scale following vegetative treatment and burning (short and mid term) where these standards are currently being met. Long term cumulative impacts described under the *Common to All Action Alternatives* section would also be greatest under this alternative.

Alternative 3

Direct and Indirect Effects

The effects under this alternative would be similar to those described under *Common to All Action Alternatives*. This alternative would commercially thin 832 fewer acres (643 acres ground-based, 128 acres helicopter with mechanical pre-bunching, and 61 acres skyline) than Alternative 2. Because it would mechanically treat vegetation on fewer acres than Alternative 2, this alternative would have less impact on downed wood in the short and mid term than Alternative 2. Average downed wood densities would meet or exceed Forest Plan minimum standards in the dry upland forest PVG at the analysis area scale following vegetative treatment and burning. Where individual units currently meet Forest Plan minimum standards, these standards are expected to be met following implementation.

Cumulative Effects

The cumulative effects of this alternative would be similar to those described under *Common to All Action Alternatives.* The cumulative impacts would be slightly less than the proposed action (Alternative 2) because there would be fewer acres of commercial thinning under this alternative. In the long term, the retention of larger untreated patches across the landscape would provide for high downed wood density areas. Under this alternative, Forest Plan standards would continue to be met or exceeded at the stand and analysis area scale following vegetative treatment and burning (short and mid term), where these standards are currently being met.

Alternative 4

Direct and Indirect Effects

The effects under this alternative would be similar to those described under *Common to All Action Alternatives*. This alternative would commercially thin the fewest acres (8,230 acres) when compared to Alternative 2 (10,000 acres) and Alternative 3 (9,170 acres). Because it would mechanically treat vegetation on the least acres, this alternative would also have the least impact on downed wood in the short and mid term when compared to the other action alternatives. Average downed wood densities are expected to meet or exceed Forest Plan minimum standards in the dry upland forest PVG at the analysis area scale following vegetative treatment and burning. Where individual units currently meet Forest Plan minimum standards, these standards are also expected to be met following implementation.

Cumulative Effects

The cumulative effects of this alternative would be similar to those described under *Common to All Action Alternatives.* The cumulative impacts of this alternative are expected to be less than both of the other action alternatives due to a reduction in commercial thinning under this alternative. In the long term, the retention of larger untreated patches and unthinned riparian habitat conservation areas across the landscape would provide for high downed wood density areas. Under this alternative, Forest Plan standards would continue to be met or exceeded at the stand and analysis area scale following vegetative treatment and burning (short and mid term), where these standards are currently being met.

MANAGEMENT INDICATOR SPECIES

The Forest Plan designates Management Indicator Species (MIS) to represent larger groups of animals associated with the major habitat types on the Forest. Habitat conditions for management indicator species must be managed to maintain viable populations (USDA 1990, page 2-9) at the Forest or larger scale. MIS species for the Forest are presented in Table W-05.

Table W-05. Umatilla National Forest Management Indicator Species (USDA 1990, page 2-9).

Species	Habitat Description	Habitat Present in Analysis Area?	Species Present in Analysis Area?
Rocky Mountain elk	General forest habitat and winter ranges	Yes	Documented
Pileated woodpecker	Dead/down tree habitat (mixed conifer) in mature and old growth stands	Yes	Documented
American three-toed woodpecker	Dead/down tree habitat (lodgepole pine) in mature and old growth stands	Yes	No
American marten	Mature and old growth stands at high elevations	Yes	No
Primary Cavity Excavators (PCEs)	Dead/down tree (snag) habitat	Yes	Documented

Rocky Mountain elk, the pileated woodpecker, and a number of primary cavity excavators are known to occur in the analysis area. There have been no observations of either the marten or the three-toed woodpecker in the analysis area. Marten and three-toed woodpecker source habitat is present within the project area. The Wheeler Point Fire (1996) area at the west end of the project area no longer contains suitable burned habitat for the three-toed woodpecker due to the age of this burn. The Sunflower Fire (2014) contains small patches of burned forest that may provide habitat for this species. Although there is limited source habitat in the analysis area, and these small patches are widely scattered, impacts on these species will be analyzed under the Kahler Project.

ROCKY MOUNTAIN ELK

AFFECTED ENVIRONMENT

The Rocky Mountain elk was selected as a MIS to be an indicator of general forest habitat and winter ranges. It is assumed that if good habitat is provided for elk and their population is maintained at some desired level, that adequate habitat is also being provided for other species that share similar habitat requirements (USDA 1990, page 2-9). Rocky Mountain elk are distributed throughout the western and eastern portions of the United States, and several Canadian provinces. Populations in the eastern United States are generally smaller and less contiguous than those found in the western United States. Preferred habitat for elk consists of a mixture of forested and non-forested habitat types and a variety of forest structures that provide cover and forage for summer and winter usage (Thomas et al. 1979, USDA 1990). Grasses constitute the majority of elk diets; however, elk will also utilize forbs, shrubs, lichens, and other vegetation, depending on the season of year and forage availability. Winter range habitat consisting of open grasslands and shrublands at low and mid elevations are required to carry elk through the critical winter period. They are primarily grazers, but also require dense forested stands for security and hiding cover. Recent research indicates that a shift in thinking regarding the selection of cover stands by elk is necessary. In the past (Forest Plan), cover stands were thought to provide an energetic advantage to elk during the winter and summer by moderating temperature and reducing energy expenditures (i.e. thermal cover). Cook and others (1998) found there to be no significant energetic benefit to elk when they tested the weather-moderating influences of forest cover (i.e., influences of wind speed, ambient temperature, and long- and short- wave radiation). Benefits were either too small, occurred too infrequently, or were too variable to provide meaningful benefits. Cook and others (1998) found that the thermal cover benefit attributed to dense forest cover is probably not operative across a considerable range of climate, including climates in boreal ecosystems of the northeastern United States, maritime ecosystems of the inland Pacific Northwest, and in cold, dry ecosystems of the central Rocky Mountains. Results of these experimental studies cannot be used to categorically reject all potential benefits of forest cover to elk, since cover continues to be selected for by elk at different times of the year. Selection patterns most likely involve needs for security and reduced vulnerability to hunters, energy savings from reduced snow deposition and associated costs of locomotion, and forage conditions (particularly late-summer forage quality) (Cook et al. 1998). It is likely that management for cover should shift from a thermal cover emphasis to one driven by these factors. Recent research indicates that roads and off road recreation influence the distribution of big game (Rowland et al. 2004, Rowland et al. 2000, Wisdom et al. 2004). Elk generally avoid roads that are open to motorized traffic. The energy expenditure related to avoidance or fleeing from off road activity and road-related disturbance can be substantial (Cole et al. 1997) and may reduce the body condition of elk and ultimately reduce the probability of surviving the winter (Cook et al. 2004). Elk have been found to avoid high quality habitat in favor of lower quality habitat with limited motorized access (Rowland et al. 2004). A reduction in open road density may decrease daily movements and the size of home ranges; these reductions could lead to energetic benefits that result in increased fat reserves or productivity (Cole et al. 1997).

Calving habitat is largely dependent on the availability of nutritious forage during the calving season (mid-May through mid-June) (Toweill and Thomas 2002). Calving generally occurs on transitional ranges with gentle topography where open foraging areas are adjacent to forested habitat (Toweill and Thomas 2002). Ground cover concealment, often in the form of shrubs, downed wood, or broken terrain, has been suggested by some to be important to elk in calving areas; however, this preference or dependence has not been quantified (Toweill and Thomas 2002).

Threats to elk and elk habitat include human development in elk habitat, loss of critical winter range habitat, overhunting, disease, reduced forage quantity and quality, predation, noxious weeds, and others (Toweill and Thomas (2002). The conservation status of the Rocky Mountain elk was identified at the global, national, and state of Oregon geographical areas by NatureServe; by listing status from Federal and State Threatened and Endangered Species lists and Sensitive Species lists; and by the Oregon Conservation Strategy. Table W-06 displays the conservation status of the elk.

Table W-06. Conservation status of the Rocky Mountain elk.

NatureServe Status			**Federal Status**		**State Status**		**Other**
Global Status	National Status	State Status	Federally Listed, Proposed,	Regional Forester's Sensitive	Threatened, Endangered, Candidate	ODFW Sensitive Species	Oregon Conservation

			Candidate, Delisted Species, Species of Concern?	Species?	Wildlife Species in Oregon?	List (2008)?	Strategy?
*G5-Secure	*N5-Secure	*S5-Secure	Not listed.	Not listed.	Not listed.	Not listed	Not a Strategy Species

* NatureServe conservation status ranks are based on a one to five scale, ranging from critically imperiled (1) to demonstrably secure (5). Status is assessed and documented at three distinct geographic scales-global (G), national (N), and state/province (S).

In the State of Oregon, the management of elk populations is the responsibility of the Oregon Department of Fish and Wildlife (ODFW). The Forest Service manages elk habitat to contribute towards the attainment of ODFW's elk management objectives. ODFW has primary responsibility for managing population structure, which includes population levels, bull/cow ratios, and calf ratios. ODFW manages the elk population in a number of ways, including the use of regulated hunting to meet management objectives (MOs) for population, bull ratios, and other metrics. The primary goal of ODFW (in relation to elk) is to manage elk populations to provide optimum recreational benefits to the public, be compatible with habitat capability and primary land uses, and contribute to a healthy ecosystem (ODFW 2003). ODFW maintains elk populations well above minimum viable levels in management areas in northeast Oregon to meet this goal. A similar situation exists in Washington, which manages elk numbers on a portion of the Umatilla National Forest.

The Kahler analysis area is situated in the Heppner and Fossil Big Game Management Units (GMUs). National Forest System lands (including lands on the adjacent North Fork John Day Ranger District) comprise approximately 28 percent (180,000 acres) and nine percent (31,000 acres) of the land in the Heppner and Fossil Game Management Units, respectively. There are approximately 399,000 acres and 82,000 acres of winter range in the Heppner and Fossil GMUs, respectively. The Monument and Kahler Basin winter ranges (all on National Forest System lands) total approximately 66,000 acres, or 14% of the winter range available in these two GMUs. There are approximately 180,000 acres of critical winter range in the Heppner and Fossil GMUs; approximately 18,000 acres, or 10% of this critical winter range lies on National Forest System lands in the Heppner and Fossil GMUs. The remainder lies on private, State of Oregon, Bureau of Land Management, and other lands. The Monument Winter Range is the largest winter range on the forest. It spans the entire southern boundary of the Heppner and North Fork John Day Ranger Districts. Elk from the Heppner, Ukiah, Fossil, and Desolation GMUs generally use the Monument Winter Range. Elk within the winter range generally do not stray to other adjacent winter ranges in a given season. Activities occurring in the Monument and Kahler Basin winter ranges do not impact habitat in other winter ranges or affect elk that use other winter ranges on the South Zone of the Umatilla National Forest. The management objective for the winter elk population is 5,000 elk in the Heppner Unit and 600 elk in the Fossil Unit (north). The current winter population is estimated to be 5,400 and 450 elk based on spring 2013 counts (ODFW 2013) in the Heppner and Fossil Units, respectively. Population counts (aerial and horseback surveys) are completed annually by ODFW in the spring prior to elk moving off of their winter range habitat. Figures W-01 and W-02 display the population trend in the Heppner and Fossil Big Game Units from 1999-2011. For the Heppner Unit, the population was stable to decreasing prior to 2006 and has been increasing since 2006. Calf ratios were also low (15-18) from 2005 through 2007; in 2008, calf ratios improved and have remained near 30 per 100 cows for the period 2008-2011. The reasons for this turnaround are believed to be related to changes in management implemented by the Oregon Department of Fish and Wildlife and identification of the Heppner Unit as a cougar target area to address a population below management objectives and low calf ratios. A similar pattern exists in the Fossil Unit. Overall, there is a slight upward trend in population. The current calf ratio is 22 per 100 cows.

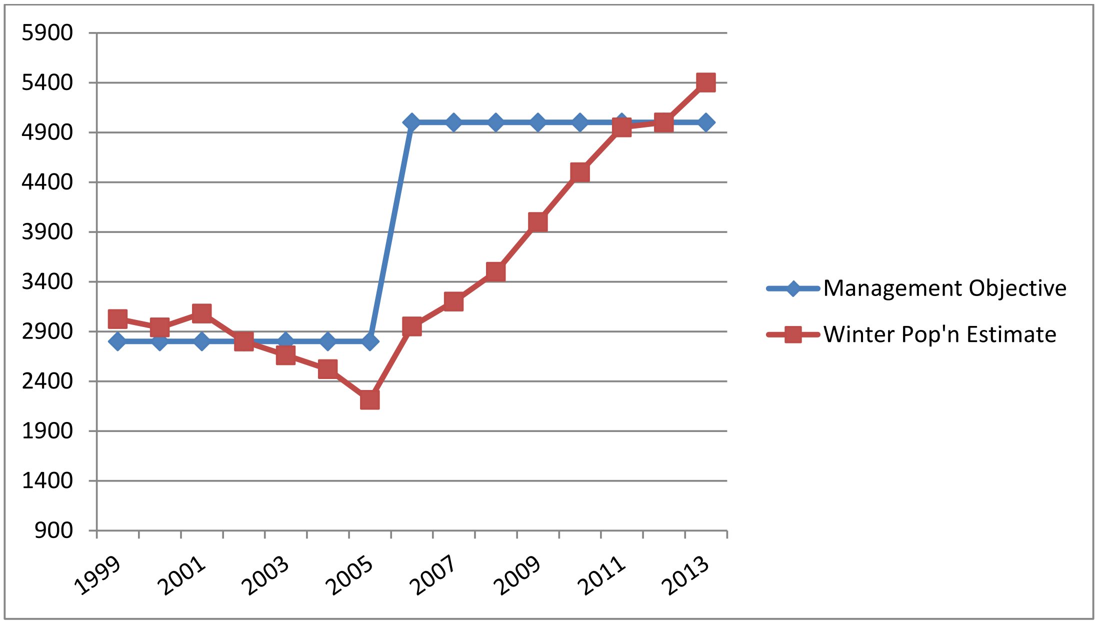

Figure W-01. Winter population estimate for the Heppner Big Game Management Unit 1999-2013.

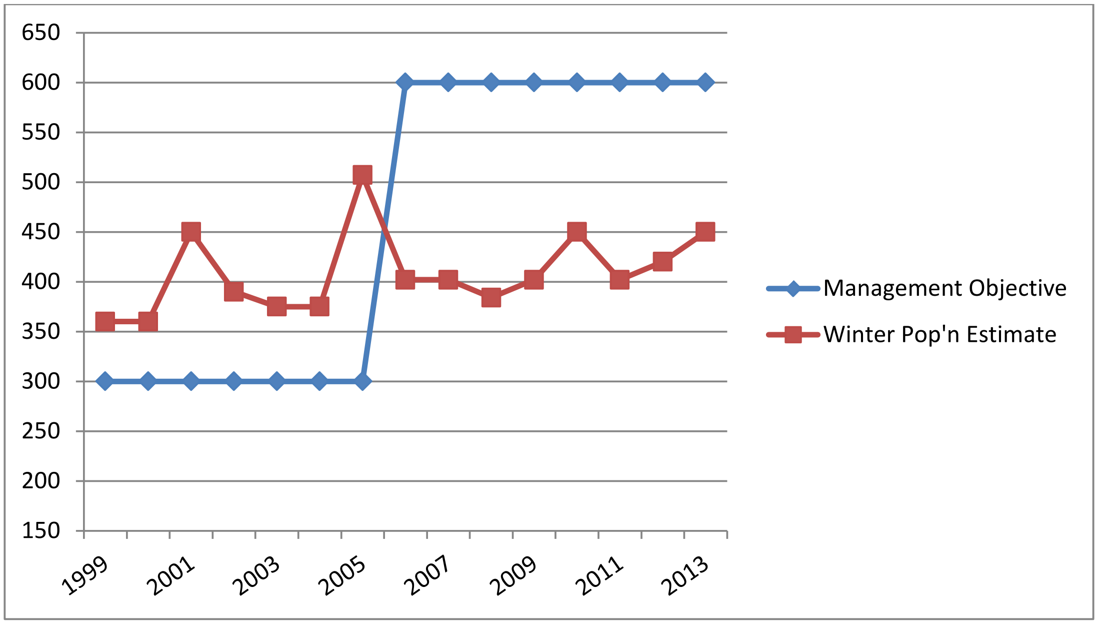

Figure W-02. Winter population estimate for the Fossil (north) Big Game Management Unit 1999-2013.

The big game habitat effectiveness model (USDA 1990, Appendix C) is used to predict the influence of forest management on elk and other big game species. The habitat effectiveness for elk is a relative index of the amount and arrangement of cover and forage areas; these factors measure the potential of a given area to achieve the maximum appropriate use of the area by the maximum number of animals (Thomas et al. 1979). The HEI value is a function of three habitat factors (variables). These habitat variables are the percent potential habitat effectiveness derived from the quality of cover in the analysis area (HEc), the percent potential habitat effectiveness achieved in response to open roads (HEr), and the percent potential habitat effectiveness in response to the suitability of size and spacing of cover and forage areas (HEs). It is intended to be a relative measure of effectiveness, and does not consider many factors (such as weather, predation, disease, hunting, harvest, etc.) that would influence the actual number of elk found in an area.

The Umatilla Forest Plan (1990) establishes standards and guidelines for elk habitat for many of the management areas on the Forest. The analysis area is composed of two management areas that have standards for big game habitat: C3 (Big Game Winter Range) and E1 (Timber and Forage). The E1 management area can be generally characterized as being mid-elevation, gentle to steep topography, with mixed openings and timbered stands on wetter aspects and in draws. Forested vegetation is largely dominated by ponderosa pine and Douglas-fir; pockets of grand fir are present in scattered moist areas, especially on north facing slopes. The Forest Plan provides direction for analyzing elk habitat effectiveness within the E1 management area at the subwatershed scale and the C3 management area at the scale of the entire winter range. Due to there being inadequate acres in the Kahler Basin winter range for an HEI run, it was combined with the Monument winter range. The E1 management area was initially split into 4 areas based on subwatershed boundaries; due to there being too few acres in several of these for a valid HEI run, they were combined. HEI was ran on the E1 West and E1 East areas. Table W-07 compares the Forest Plan standards with the current condition of elk habitat in the analysis area.

Table W-07. A comparison of standards and existing conditions for Rocky Mountain elk habitat in the Kahler analysis area.

Management Area	Forest Plan Standards			Kahler Existing Condition			
	HEI	Satisfactory Cover	Total Cover	HEI	Satisfactory Cover	Total Cover	Open Road Density
C3	70	10% (Minimum)	30%	58	1.5% (967 acres, with 439 in project area)	13.9% (8,785 acres, with 1,685 in project area)	0.5 mi/sq mi
E1 West	30	None	None	30	0% (0 ac)	4.9% (335 ac)	2.5 mi/sq mi
E1 East	30	None	None	55	1.3% (175 ac)	28.6% (3,874 ac)	2.0 mi/sq mi

Dark-gray shaded fields indicate values currently below Forest Plan standards.

The current habitat effectiveness index (HEI) value is 30 for the E1 West, 55 in the E1 East, and 58 in the C3 management area. The HEI values in the E1 both currently meet the Forest Plan standard; the current HEI in the C3 management area does not meet the Forest Plan standard for HEI. While existing cover levels are quite low, there are currently no Forest Plan standards in the E1 management area for cover. In the C3 management area, Satisfactory Cover and Total Cover are currently below Forest Plan standards. The existing cover values are likely the result of the legacy of past management activities and the low natural potential of the hot/dry and warm/dry biophysical environments to sustain satisfactory cover in the long-term. The ability of an area to produce cover habitat is a function of multiple variables, including moisture, the potential vegetation, disturbance (fire, windthrow, insects and disease, etc.), and physical habitat features like aspect. Lower elevation areas, stands on south facing slopes, and stands dominated by ponderosa pine are less capable to produce high quality cover (dense overstory and heavy understory vegetation, generally small diameter trees) than higher, more moist stands.

The evaluation criteria used in this analysis to measure impacts to elk and their habitats are total cover, satisfactory cover, habitat effectiveness index, and elk vulnerability. Open road density will be evaluated as a component of the habitat effectiveness index; a proximity analysis of cover and forage to open roads will also be utilized to analyze impacts on elk and elk habitat.

Recent research indicates that roads and off road recreation influence the distribution of big game (Rowland et al. 2004, Rowland et al. 2000, Wisdom et al. 2004). Elk generally avoid roads that are open to motorized traffic. The energy expenditure related to avoidance or fleeing from off road activity and road-related disturbance can reduce the body condition of elk and ultimately reduce the probability of surviving the winter (Cook et al. 2004). In addition to HEI, a proximity analysis of open roads (open to OHVs and/or pickups) to elk habitat (forage, marginal, and satisfactory cover) will be used to analyze the effects of the various action alternatives on elk and elk habitat. Research indicates that elk respond to motorized vehicles by avoiding cover and foraging areas adjacent to open roads (Rowland et al. 2000, Rowland et al. 2004). Areas greater than 0.5 miles from roads open to motorized vehicle use are considered security or refuge areas where elk are less likely to be impacted by motorized vehicle use. In these security areas, elk would be less likely to respond to the sound of vehicle use on roads, and would have the opportunity to fully utilize available habitat. Open roads were buffered in GIS by 0.5 miles to determine the amount of security habitat (forage, satisfactory cover, and marginal cover) available within the analysis area. In addition to distance from open roads, the terrain and vegetation also have the potential to influence the degree to which elk respond to vehicles and other activities that may cause disturbance. The results of the proximity analysis are described in Table W-08 below.

Table W-08. Road proximity analysis for the Kahler Project area: acres of habitat greater than 0.5 miles from open roads.

Management area	Total acres in analysis area	Habitat Type		
		Forage (acres)	Marginal Cover (acres)	Satisfactory Cover (acres)
C3	62,930	4,444	492	160
E1 East	13,572	648	327	0
E1 West	6,841	78	0	0

This data indicates that there is little security habitat, especially cover, under the existing condition and that elk likely respond to motorized vehicle use by expending energy (fleeing). The results of this proximity analysis indicate that the lack of security habitat in the analysis area may be in part responsible for the tendency of elk to move to adjacent private lands or adjacent NFS lands during high-disturbance periods (i.e., hunting season).

ENVIRONMENTAL CONSEQUENCES

No Action

Direct and Indirect Effects

In the short term, elk habitat would remain unchanged. The amount of satisfactory and total cover and the HEI value in the E1 East, E1 West, and C3 management areas would remain the same in the short term. In the mid and long term, stands would continue to grow, recover from past disturbance, and develop a multistory structure, increasing the amount of total cover in the E1 and C3 management areas to a small degree. Satisfactory and total cover levels in the C3 management area would approach Forest Plan standards in the long term as stands regenerate from past disturbance and stands develop in the absence of fire. In the mid and long term, HEI in the E1 East, E1 West, and C3 management areas would likely increase as the cover-to-forage ratio increases, and the distribution of cover and forage across these management areas changes.

An increase in cover and multi-layer condition would increase the risk of high-severity wildland fire. It is expected that mixed severity fire would occur; however, there would be larger patches of high severity impacts due to higher flame lengths and resulting passive crown fire. Larger, more contiguous patches of habitat would experience high overstory mortality than would have been expected historically. High-severity burned patches would result in a reduction of total cover and satisfactory cover in the analysis area, and an increase in foraging habitat. If a fire of this type occurred in the E1 or C3 management area, HEI may decrease due to an increased abundance of forage habitat and a reduction in cover. Elk populations would likely decrease (due to a redistribution of the population within their range, not direct impacts of a fire to individuals) soon after a disturbance such as this, but would increase in response to forage stimulated by fire. Open road densities are not expected to change in the short or long term.

Common to All Action Alternatives

Direct and Indirect Effects

Vegetation that provides elk habitat would be treated by all of the action alternatives. Commercial thinning activities would reduce canopy closure in affected stands and convert stands from a cover condition to foraging habitat. Table W-09 shows post-treatment HEI and cover levels under Alternatives 2, 3, and 4. While HEI would continue to meet Forest Plan standards in the E1 East, it would fall below the Forest Plan standard in the E1 West under all of the action alternatives. In the C3 management area, satisfactory cover and total cover would be reduced further below Forest Plan standards under all of the action alternatives. HEI would be reduced further under Alternatives 2 and 3; HEI would not change under Alternative 4. Forest Plan amendments would be required to implement the proposed activities in the E1 West and C3 management areas. These amendments would change the standards for total cover, satisfactory cover, and HEI to the post-treatment levels described below in Table W-09 for the duration of the project. Refer to the individual alternative discussions below for specific impacts related to the activities proposed under these alternatives.

Table W-09. Post-harvest condition of Rocky Mountain elk habitat in the Kahler analysis area.

Management Area	HEI	% Satisfactory Cover	% Total Cover
C3 – Monument and Kahler Winter Ranges, combined			
Forest Plan Standard	70	10	30
Existing Condition/No Action	58	1.5	13.9
Alternative 2 (Proposed Action)	57	1.4	12.9
Alternative 3	57	1.4	13.0
Alternative 4	58	1.4	13.2
E1 East – Timber and Forage			
Forest Plan Standard	30	No Standard	No Standard
Existing Condition/No Action	55	1.3	28.6
Alternative 2 (Proposed Action)	51	0.5	8.2
Alternative 3	52	0.6	11.2
Alternative 4	54	0.9	13.1
E1 West – Timber and Forage			
Forest Plan Standard	30	No Standard	No Standard
Existing Condition/No Action	30	0.0	4.9
Alternative 2 (Proposed Action)	29	0.0	1.4
Alternative 3	29	0.0	2.2
Alternative 4	29	0.0	2.2

Dark-gray shaded fields indicate values below Forest Plan standards.

Dense stands (cover) are selected by elk for bedding and escape from predators or other disturbances. Cover stands are also used for foraging. Cover is evaluated as a component of HEI; however, evaluation of impacts to the availability and distribution of cover habitat across a planning area can be helpful in determining potential impacts to elk distribution. Please refer to the Affected Environment section and the Terrestrial Wildlife Specialist Report for a discussion of the Habitat Effectiveness Index model and new research regarding the importance of cover habitat and the basis of selection by elk for cover habitat. Table W-10 shows impacts to cover habitat under the action alternatives.

Table W-10. Impacts to cover habitat by alternative

		Alternative			
Management Area	**Key Indicators**	**1**	**2**	**3**	**4**
C3	Satisfactory cover converted to forage (acres)	0	93	93	60
	Marginal cover converted to forage (acres)	0	599	512	366
E1 East	Satisfactory cover converted to forage (acres)	0	111	91	54
	Marginal cover converted to forage (acres)	0	2,654	2,258	2,046
E1 West	Satisfactory cover converted to forage (acres)	0	0	0	0
	Marginal cover converted to forage (acres)	0	237	184	181

Commercial thinning (with skips and gaps) would reduce stand densities and increase sight distances in cover stands under all of the action alternatives. Commercial thinning (ground based, skyline, and helicopter) would convert cover stands to foraging habitat. Cover stands lying in some Class IV RHCAs would be converted to forage under Alternatives 2 and 3; no treatment other than prescribed fire would occur in RHCAs under Alternative 4. Refer to Table W-10 above for the impacts of the alternatives on existing cover habitat. Approximately 10 to 15% of commercially thinned stands would be retained in untreated skips. These skips would generally be small (0.5 acres up to several acres), with a few larger. They would largely not provide effective cover, but would help in reducing sight distances in treated stands to some degree. Prior to treatment, elk would have used these areas for bedding during the day, and hiding cover to escape predators or other disturbances. Reduced stem densities, reduced small-diameter conifer patches (hiding cover), and stand complexity resulting from commercial thinning would alter elk distribution in the project area in the short and mid-term. Elk would be less likely to linger in these stands because they would be more visible, especially where treated stands are adjacent to roads. Elk would be more vulnerable to hunting due to increased sight distances. At the scale of the Heppner and Fossil Big Game Management Units, population level impacts would not be measurable. Given the already low cover levels in the project area, elk would likely spend less time on public (National Forest System) lands following treatment, especially during high disturbance periods associated with the late summer and fall hunting seasons. The degree to which this may occur would vary by alternative based on acres of cover converted to a forage condition and other activities that would reduce disturbance and elk vulnerability (i.e., road closures). Forage would be stimulated by thinning activities (and accentuating existing openings with gaps) that open up closed canopy dry upland forest stands. Forage improvement would largely be realized in the spring and early summer; more open stand conditions would accelerate the curing out of vegetation in treated stands (Long et al. 2008). Cover stands and other untreated, dense stands (riparian areas, dry and moist upland stands) would continue to provide green forage in the summer and early fall; elk may use these stands earlier due to accelerated curing of vegetation in treated stands.

Shrub-steppe enhancement treatments would also reduce stand densities. This treatment would thin and/or remove invading conifers (young juniper, ponderosa pine, Douglas-fir, etc.) from historically open shrublands, grasslands, and open woodlands to improve upland shrub vigor and recruitment. This activity would also make elk more visible; however, winter and spring forage would improve in response to these treatments. Alternatives 2 and 3 would enhance shrub-steppe habitat on 1,540 acres; Alternative 4 would treat slightly fewer acres (1,465 acres) to enhance shrub-steppe habitat. As a result, the impacts associated with these activities would be similar under these alternatives.

Non-commercial thinning (NCT) would reduce small-diameter tree densities in past harvest units and other areas where conifer encroachment (in the absence of fire) has occurred. Sight distances would increase and hiding cover would decrease as a result of this activity. Vulnerability of elk would increase, especially where NCT units are adjacent to open roads. Non-commercial thinning would also occur in some commercial thin units; vulnerability would increase the most on these acres because they would have the greatest impact on low-level cover and increase in sight distances. Maintenance of untreated islands of regenerating conifers within non-commercially thinned stands (Design Criteria WL14) would reduce potential impacts to some degree. Removal of a portion of the small-diameter trees in these stands would stimulate grass and forb growth where overstory canopy closure allows, improving forage for elk.

The proposed activities have the potential to affect elk calving habitat through the disturbance of understory vegetation and downed wood used for cover during calving season. Spring burning would generally be limited to activity fuels treatment. As a result, the potential to disturb calving activities would be quite low. Fall burning has the potential to impact low vegetation and downed wood potentially used for cover. Low-intensity underburning would consume accumulated small-diameter litter, dead vegetation and grass, and logging slash. Larger diameter downed wood may also be impacted; however, fuel moisture, weather, and careful application (hand, ATV torch, or helicopter) of fire by experienced personnel would combine to limit charring and consumption of these habitat features. It is not expected that treatment activities would negatively impact calving habitat or result in reductions in calf survival due to the availability of untreated areas (unburned habitat adjacent to active burn units) in the project area, and the fact that only a portion of the acres within the burn blocks (average approximately 70%) are expected to be blackened. Burning proposed in all action alternatives would have neutral or beneficial effects on elk cover and foraging habitat. Growth of grasses and forbs would be stimulated by burning, improving forage conditions for elk in the short term, especially during the spring and early summer (Long et al. 2008). Low-level cover provided by shrubs and small diameter trees may be reduced in the short and early mid-term, but would recover over time. The quality of marginal and satisfactory cover would not be affected by low-intensity underburning due to the fact that overstory vegetation generally would not be impacted (Harrod et al. 2009). Occasional single trees and groups of trees may be killed in these areas, but overall cover levels are not expected to be impacted. Design criteria would be implemented to reduce potential impacts to cover habitat. Burning would occur over a 5 to 10 year period; as a result, fall and winter forage for big game would be available and well distributed through the project area.

Use of the road system, particularly closed system roads, would increase road-related disturbance in the project area. Elk would likely avoid these roads during implementation in favor of areas with fewer disturbances. After implementation, these roads would be closed with the existing closure device (sign, gate, or barricade). Because these roads would be cleared, the potential for non-permitted OHV use would increase following implementation. Temporary road construction, new road construction (0.4 miles that would be closed year-round), and use of these roads would cause disturbance and result in potential non-permitted use. The newly constructed road (0.4 miles) would be closed to full sized vehicles year round, but open to OHVs from April 15 to November 30 (winter range closure). It would replace an existing seasonally closed OHV trail (0.4 miles of system road) that would be closed and decommissioned; as a result, there would be no net increase in open route density. Temporary roads would be decommissioned to the greatest degree possible following implementation. In addition, existing temporary roads that are added back into the road system (all would be closed to motorized travel year-round) would be blocked, barricaded, and/or signed to reduce the risk of non-permitted use. All of the action alternatives would reduce road related disturbance to some degree though the closure of open forest roads. Miles of temporary road, closed roads used, haul routes, and proposed road closures will vary by alternative. Refer to individual alternative descriptions for specific details related to these activities.

Tables W-11, W-12, and W-13 below show the post-implementation (vegetative treatment and road closure) availability of habitat greater than 0.5 miles from open roads. Under the three action alternatives there would be varying levels of security habitat available in the analysis area. Refer to individual alternatives discussions for a full discussion of the road proximity analysis.

Table W-11. Post treatment road proximity analysis: habitat greater than 0.5 miles from open roads in the E1 Management Area (West).

Alternative	Forage* (acres)	Marginal Cover (acres)*	Satisfactory Cover (acres)*
Existing Condition/No Action	78	0	0
Alt 2 (Proposed Action)	188	0	0
Alt 3	197	9	0
Alt 4	197	9	0

*Includes impacts associated with vegetative treatment under the Kahler Project

Table W-12. Post treatment road proximity analysis: habitat greater than 0.5 miles from open roads in the E1 Management Area (East).

Alternative	Forage* (acres)	Marginal Cover (acres)*	Satisfactory Cover (acres)*
Existing Condition/No Action	648	327	0
Alt 2 (Proposed Action)	1,418	89	0
Alt 3	1,434	179	0
Alt 4	1,400	213	0

*Includes impacts associated with vegetative treatment under the Kahler Project

Table W-13. Post treatment road proximity analysis: habitat greater than 0.5 miles from open roads in the C3 Management Area (within the Project Area).

Alternative	Forage* (acres)	Marginal Cover (acres)*	Satisfactory Cover (acres)*
Existing Condition/No Action	4,444	492	160
Alt 2 (Proposed Action)	4,951	283	95
Alt 3	4,866	369	95
Alt 4	4,828	387	115

*Includes impacts associated with vegetative treatment under the Kahler Project

Overall, Tables W-11, W-12, and W-13 indicate that there would be an increase in total acres (forage and cover combined) that are greater than 0.5 miles from an open road in the C3, E1 West, and E1 East management areas within the project area (C3 acres here do not extend outside the project area as it did in the HEI analysis). This increase would be due to road closures that would be implemented under Alternatives 2, 3, and 4. Increased forage that is distant from open roads would improve late spring and early summer forage for elk by reducing motorized disturbance and access in these areas. While the acres of forage greater than 0.5 miles from an open road would increase, the amount of cover greater than 0.5 miles from an open road would generally decrease under all of the action alternatives due to effects related to mechanical vegetative treatment. In the late summer and fall, once hunting seasons begin, it would be less likely that elk would linger in these stands. This reduction may contribute to the tendency for elk to move elsewhere (off NFS lands or to National Forest lands outside the Kahler area) during the late summer and fall during high disturbance periods (hunting seasons). Currently, elk tend to move off forest from areas adjacent to the Forest boundary and in the portion of the Kahler area west of Highway 207 due to disturbance during the late summer and fall. Adjacent private lands are generally closed to hunting or are leased, providing little hunting opportunity. Conflicts also arise between elk and other lands uses on private lands (depredation of crops, damage to fences, etc.) when they move off of National Forest System lands. As these levels vary by alternative, refer to individual alternative discussions for details.

Cumulative Effects

Past activities and events in the analysis area that affected elk habitat include timber harvest (commercial thinning, overstory removal, and regeneration harvest), road construction, road closures (Access and Travel Management), ATV trail use, wildfire, and livestock grazing. Timber harvest has affected forest structure and composition on approximately 18,550 acres in the project area since the year 1975. Timber harvest (commercial thinning, regeneration harvest, and overstory removal) has occurred on approximately 33,000 acres within the Monument and Kahler Basin Winter Ranges (analysis area for C3 management area) since 1980. This figure includes recent treatments under the Falls-Meadowbrook, Rimrock, Sunflower Bacon, and Wildcat II projects. Considerable overlap is present between treatments (e.g. commercial thinning is followed by regeneration harvest on the same acres), so the actual acres affected by these activities would be less. Elk cover habitat was reduced through these activities. Conversely, the amount of foraging habitat for big game has increased in response to past harvest. Timber harvest has also fragmented habitat, creating a mosaic of forested stands and man-made openings. The existing Habitat Effectiveness Index for the winter range (Monument and Kahler Basin combined) also accounts for activities that have occurred in these project areas. Vegetation data quality has improved through time; the best available vegetation data was used for calculating the existing HEI, making comparisons to past calculations under Rimrock, Falls-Meadowbrook, and other projects difficult. An unknown amount of timber harvest has occurred on private lands adjacent to the Forest. Road construction associated with timber harvest increased road densities and disturbance within the analysis area. Increased open road densities make elk more vulnerable; research has found that they tend to select for habitats further away from open roads. More recently, road closures associated with access and travel management activities on the south end of the Umatilla National Forest (mid-1990s) and prohibition of cross-country ATV travel in the Kahler area (2009) have reduced road densities and disturbance. ATV trail construction and trail designation on closed system roads has resulted in disturbance during the summer riding season and hunting season. Wildfire within the analysis area has impacted elk habitat. The Wheeler Point Fire impacted approximately 6,540 acres of NFS lands in the Kahler analysis area. The Monument Complex Fire also affected elk habitat in the Monument Winter Range. Dense cover habitat was generally consumed in these fires; forage was stimulated, and remains high quality in some areas. Most recently, the Sunflower Fire affected vegetation providing elk cover in the southern portion of the winter range (outside of the Kahler Project Area). Approximately 162 acres of marginal cover lying within the winter range burned at a high or moderate severity. This represents approximately 2% of the cover that is currently available in the Monument Winter Range. It is assumed that immediate and delayed overstory mortality in these stands would convert these stands to a forage condition. As stands in these fire areas are quite dry, they are still very open; little structure capable of hiding a standing elk is available. Historic livestock grazing (sheep and cattle) around the early part of the 20th century negatively impacted range condition in the three allotments that currently lie within the analysis area. Grazing altered the structure and composition of foraging habitat through repeated overgrazing of rangelands. More recent grazing (approximately 1960 to present) ensures a shared allocation of forage between wild and domestic ungulates. Current grazing is consistent with Forest Plan direction, and is meeting Forest Plan utilization and stubble height standards. Past activities have resulted in the current condition of elk habitat in the Kahler analysis area.

Ongoing activities, actions, and events that affect elk and elk habitat include cattle grazing. Current grazing is not adversely affecting rangeland condition or adversely affecting wild ungulate (elk) populations. Livestock grazing still has the potential to compete with big game for forage habitat, particularly when forage is scarce (late summer/early fall). Current allotment management plans balance livestock utilization with big game management objectives, resulting in a shared utilization of the forage resource. Current grazing is consistent with Forest Plan direction and is meeting Forest Plan utilization and stubble height standards.

Reasonably foreseeable future activities, actions, and events that have the potential to affect elk and elk habitat include cattle grazing and prescribed burning. Cattle grazing would have the same effects as those discussed in the present activities section. Prescribed burning in winter range and summer range would generally have beneficial impacts on forage quantity and quality for elk.

When the expected effects of these alternatives are combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be a cumulative reduction in elk cover habitat under all of the action alternatives. This would be the result of harvest impacts on stand structure, composition, and canopy closure in dry and moist upland forest stands. This incremental reduction in cover would add to past reductions in the project area (and larger winter range area for the C3 Management Area) resulting from timber harvest and wildfire, maintaining or moving some management areas below Forest Plan standards for elk habitat. This cumulative reduction in cover habitat would increase elk vulnerability to hunting and may alter elk distribution at the analysis area scale during the hunting and non-hunting seasons. Road closures proposed under the action alternatives would partially compensate for this loss of cover by cumulatively reducing motorized disturbance in the analysis area. Refer to individual alternative discussions for additional information.

Alternative 2

Direct and Indirect Effects

The effects of this alternative would be similar to those described under *Common to All Action Alternatives*. This alternative would commercially thin (with skips and gaps) the most acres when compared to the other action alternatives. This alternative would also have a larger impact on cover habitat (3,694 acres) than Alternative 3. Of this total, approximately 691 acres occur in C3, 237 acres in E1 (West), and 2,766 acres in E1 (East). In terms of cover availability, this would equate to an 8% reduction in the C3, a 71% reduction in the E1 (West), and a 71% reduction in the E1 (East) area. Cover patches would be less numerous across the landscape and would be smaller when compared to the existing condition. In general, cover patches would be available in riparian areas, C1 old growth stands, and a few untreated moist and dense dry forest patches following implementation.

This alternative would also use the most miles of closed system roads to access proposed treatment units. Approximately 58 miles of closed road would be used under this alternative. This alternative would also require the most temporary road to implement. Approximately 3 miles of new temporary road would be constructed and 7 miles of existing temporary roads would be required for implementation. As a result, short term disturbance to elk in the vicinity of these reopened and temporary routes would be greatest under this alternative. Because this alternative would reopen the most miles of closed road and construct the most temporary road, it would also have the greatest potential for non-permitted OHV use following treatment. Under this alternative, 9 miles of road would be closed year round and 7.5 miles closed seasonally (during the winter period December 1 thru April 14) to mitigate for cover lost through vegetative treatment activities. A portion of these roads pass through or access proposed treatment units; closure of several others would reduce disturbance to big game in the winter range management area and general forest habitat used during the late winter, spring, and early summer. These closures would improve post-treatment elk habitat to some degree by reducing potential disturbance associated with motorized vehicle use.

The road proximity analysis indicates that there would be no change in the availability of satisfactory cover that is greater than 0.5 miles from an open road in the E1 (East and West) management area. In the C3 management area, satisfactory cover greater than 0.5 miles from an open road would decrease from 160 to 95 acres (-41%) under this alternative. There would be no change in the availability of marginal cover that is greater than 0.5 miles from an open road in the E1 (West). Marginal cover greater than 0.5 miles from an open road would drop from 327 to 89 acres (-73%) and 492 to 283 acres (-42%) in the E1 (East) and C3 management areas, respectively. In the E1 (East), E1 (West), and C3 management areas, the availability of forage greater than 0.5 miles from an open road would increase 119%, 141%, and 11%, respectively.

When the impacts to cover habitat, HEI, the road system, and security habitat are combined, Alternative 2 would have the most impact on elk and their habitat when compared to the other alternatives. Alternative 2 would impact the most acres of cover, result in the greatest reduction in security habitat (cover), and reduce disturbance to a lesser degree than would Alternatives 3 and 4. Reductions in cover availability, security habitat (cover), and the availability of spring and summer forage would likely impact the distribution of elk. In the late winter, spring, and early summer, the improvement in the quality and quantity of forage resulting from vegetative treatment and burning and road closures (seasonal and year-round) would improve elk distribution and may pull elk off of adjacent private lands. Elk would likely be concentrated in and around untreated cover stands and riparian areas where green, nutritious forage is present in the late summer. With the onset of fall hunting seasons (high disturbance period starting in late August), it is likely that elk would spend a greater proportion of their time, and longer periods of time, on private lands adjacent to the Forest, or on NFS lands adjacent to the Kahler Project area due to reductions in cover in the project area. These areas tend to have less vehicular traffic and human disturbance (walking, pursuing, etc.) than adjacent National Forest System lands.

Alternative 2 would require a site-specific Forest Plan amendment to treat cover habitat in the E1 (West) and C3 management areas. In the C3 management area, the total cover, satisfactory cover, and HEI standards would be amended to the post treatment levels of 12.9%, 1.4%, and 57 for the duration of the Kahler Project. In the E1 (West) management area, the HEI standard would be amended to the post treatment level of 29 for the duration of the Kahler Project. The direct and indirect effect of the amendment is that elk habitat quality would be reduced further below current Forest Plan standards, with consequent changes in elk distribution described above.

Cumulative Effects

The cumulative effects of this alternative on elk and elk habitat would be similar to those described under *Common to All Action Alternatives*. When the expected effects of Alternative 2 are combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be an incremental reduction in cover that would add to past reductions in the project area resulting from timber harvest and wildfire. Impacts to elk cover, elk vulnerability, and elk distribution in the short and early mid term would be the greatest under this alternative. Given the already low cover values and HEI in a portion of the analysis area, further reduction of cover under this alternative would result in shifts in the distribution of elk during the summer and fall hunting season. Elk would likely spend more time in the untreated high density dry and moist upland forest patches that persist following implementation. These stands would generally be situated along streams (RHCAs), in Dedicated Old Growth stands, or in the few dense moist and dry upland forest stands dropped during project development. When disturbed, it is likely that elk would move off of NFS lands more often and for longer periods of time, largely due to a lack of stands where they can feel secure when confronted with a disturbance (i.e. motorized vehicles, hunters, etc.).

Forest Plan Consistency

Because Alternative 2 would reduce cover habitat for elk, the overall direct, indirect and cumulative effects would result in a negative habitat trend at the Forest scale. At the Forest scale, cumulative impacts associated with implementation of Alternative 2 would not result in short or long term population reductions due to the size of the affected area. While this alternative would require a Forest Plan amendment to meet silvicultural goals of moving the analysis area toward the HRV for the structure and composition of dry upland forest vegetation, it would provide for a relatively high level of HEI in the C3 and E1 (East) management areas, and would contribute toward meeting the numerical management objectives of the Oregon Department of Fish and Wildlife, which are well in excess of minimum viable populations. Thus, the continued viability of elk is expected on the Umatilla National Forest, and hunting opportunities will be available at similar levels to those currently available in the Heppner and Fossil Management Units. The Forest Plan would be amended to permit treatment of satisfactory and marginal cover and to reduce HEI. This would be consistent with the overall goals of the E1 management area, which are to emphasize production of wood fiber (timber) and encourage forage production (USDA 1990, pg 4-178). This alternative would also be consistent with the goals of the C3 management area, which are to provide high levels of potential habitat effectiveness and high quality forage for big game species.

Alternative 3

Direct and Indirect Effects

The effects of this alternative would be similar to those described under *Common to All Action Alternatives*. This alternative would commercially thin fewer acres than Alternative 2. Alternative 3 would convert approximately 3,138 acres of cover to forage. Of this total, approximately 605 acres occur in C3, 184 acres in E1 (West), and 2,349 acres in E1 (East). In terms of cover availability, this would equate to an 7% reduction in the C3, a 55% reduction in the E1 (West), and a 61% reduction in the E1 (East) area. Cover patches would be less numerous across the landscape and would be smaller when compared to the existing condition. Cover patches would be available in riparian areas, C1 old growth stands, untreated moist forest stands, and dense dry forest patches distributed through the analysis area. Retention of dense dry upland forest stands (often these are associated with water and springs) distributed across the landscape would provide for areas where elk would be able to escape during high use periods (i.e. hunting seasons), and provide green, palatable forage in the late summer. This alternative would also retain several units in the Wheeler Point burn that are providing structure in the middle of the otherwise open burn area. While these areas do not currently provide marginal cover, they will in the mid and long term.

Under this alternative, 9.9 miles of road would be closed year round (slightly more than Alternative 2) and 5.7 miles closed seasonally (less than Alternative 2) to partially compensate for cover lost through vegetative treatment activities. A portion of these roads pass through or access proposed treatment units; closure of several others would reduce disturbance to big game in the winter range management area and general forest habitat used during the winter and early spring. These closures would improve post-treatment elk habitat to some degree by reducing potential disturbance associated with motorized vehicle use in winter range and summer range/general forest. A portion of the proposed seasonal road closure on the 2408-020 road would be dropped under this alternative due to the fact that it would not occur in winter range habitat; year round closure of the last 0.5 miles of this road would improve post-treatment habitat conditions for elk due to the proximity of treatment units in this area. This alternative would utilize 4.7 fewer miles of closed roads (53.5 miles total), 1.6 fewer miles of existing temporary road (8.4), and the same miles of new temporary road construction. As a result, the direct and indirect effects on elk resulting from road use and construction and potential non-permitted OHV use would be less than those under Alternative 2.

The road proximity analysis indicates that Alternative 3 would provide the same number of acres of satisfactory cover greater than 0.5 miles from an open road as Alternative 2. Alternative 3 would provide more acres (+9, +90, and +86 acres in the E1 West, E1 East, and C3 areas, respectively) of marginal cover greater than 0.5 miles from an open road than Alternative 2. Alternative 3 would provide more acres of forage (+9 west, +16 east) in the E1 and fewer acres of forage (-85) in the C3 that are distant from open roads. These differences are largely due to acres dropped from treatment and to a lesser extent additional road closures under Alternative 3. As a result, the expected impacts to elk habitat and elk distribution would likely be less than those expected under Alternative 2.

When the impacts to cover habitat, HEI, the road system, and security habitat are combined, Alternative 3 would have less impact on elk and their habitat than Alternative 2. Alternative 3 would provide larger patches of cover distributed across the landscape, generally result in more acres of security habitat (cover and forage) being available, and reduce disturbance to a greater degree than would Alternative 2. Reductions in cover availability, security habitat (cover), and the availability of spring and summer forage would likely impact the distribution of elk. In the late winter, spring, and early summer, the improvement in the quality and quantity of forage resulting from vegetative treatment and burning and seasonal closure of roads in C3 winter range would improve elk distribution and may pull elk off of adjacent private lands. Elk would likely be concentrated in and around untreated cover stands and riparian areas where green, nutritious forage is present in the late summer. With the onset of fall hunting seasons (high disturbance period starting in late August), it is likely that elk would spend a greater proportion of their time, and longer periods of time, on private lands adjacent to the Forest, or on NFS lands adjacent to the Kahler Project area due to reductions in cover in the project area. The greater availability of cover stands under this alternative would provide more area than Alternative 2 in terms of hiding and escape cover.

Alternative 3 would require a site-specific Forest Plan amendment to treat cover habitat in the E1 (West) and C3 management areas. In the C3 management area, the total cover, satisfactory cover, and HEI standards would be amended to the post treatment levels of 13.0%, 1.4%, and 57 for the duration of the Kahler Project. In the E1 (West) management area, the HEI standard would be amended to the post treatment level of 29 for the duration of the Kahler Project. The direct and indirect effect of the amendment is that elk habitat quality would be reduced further below existing Forest Plan standards, with consequent changes in elk distribution described in the *Common to All Action Alternatives* section. These changes would exacerbate the existing pattern of elk moving off National Forest System lands during high disturbance periods in the western portion of the Kahler analysis area.

Cumulative Effects

The cumulative effects of this alternative on elk and elk habitat would be similar to those described under *Common to All Action Alternatives*. When the expected effects of Alternative 3 are combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be an incremental reduction in cover that would add to past reductions in the analysis area resulting from timber harvest, wildfire, and other activities. The expected impacts to elk cover, elk vulnerability, and elk distribution would be less under this alternative than Alternative 2. While elk would still be likely to move off NFS lands (or at least out of the project area) more often and for longer periods due to low cover levels and motorized disturbance, the retention of larger cover patches distributed across the landscape under Alternative 3 would provide for areas where elk could feel secure during high use periods like hunting season. This alternative would reduce potential motorized disturbance (through 9.9 miles of year-round road closure and 5.7 miles of seasonal road closure) to a greater degree than Alternative 2 and virtually the same amount as Alternative 4.

Forest Plan Consistency

Because Alternative 3 would reduce cover habitat for elk, the overall direct, indirect and cumulative effects would result in a negative habitat trend at the Forest scale. At the Forest scale, cumulative impacts associated with implementation of Alternative 3 would not result in short or long term population reductions due to the size of the affected area. While this alternative would require a Forest Plan amendment, it would provide for a relatively high level of HEI in the C3 and E1 (East) management areas, and would contribute toward meeting the numerical management objectives of the Oregon Department of Fish and Wildlife, which are well in excess of minimum viable populations. Thus, the continued viability of elk is expected on the Umatilla National Forest, and hunting opportunities will be available at similar levels to those currently available in the Heppner and Fossil Management Units. The Forest Plan would be amended to permit treatment of satisfactory and marginal cover and to reduce HEI. This would be consistent with the overall goals of the E1 management area, which are to emphasize production of wood fiber (timber) and encourage forage production (USDA 1990, pg 4-178). This alternative would also be consistent with the goals of the C3 management area, which are to provide high levels of potential habitat effectiveness and high quality forage for big game species.

Alternative 4

Direct and Indirect Effects

The effects of this alternative would be similar to those described under *Common to All Action Alternatives*. This alternative would commercially thin and convert cover habitat to forage on the fewest acres when compared to Alternatives 2 and 3. Alternative 4 would convert approximately 2,707 acres of cover to forage. Of this total, approximately 426 acres occur in C3, 181 acres in E1 (West), and 2,100 acres in E1 (East). In terms of cover availability, this would equate to an 5% reduction in the C3, a 54% reduction in the E1 (West), and a 54% reduction in the E1 (East) area. Cover patches would be less numerous across the landscape and would be smaller when compared to the existing condition. Cover patches would be available in riparian areas (no treatment except prescribed fire would occur in Class IV RHCAs), C1 old growth stands, untreated moist forest stands, and dense dry forest patches distributed through the analysis area. Retention of dense dry upland forest stands (often these are associated with water and springs) distributed across the landscape would provide for areas where elk would be able to escape during high use periods (i.e. hunting seasons), and provide green, palatable forage in the late summer. This alternative would also retain several units in the Wheeler Point burn that are providing structure in the middle of the otherwise open burn area. While these areas do not currently provide marginal cover, they will in the mid and long term. Cover patches in Class IV RHCAs and areas that require new temporary road construction would also be retained under this alternative.

This alternative would close (year-round and seasonally) virtually the same amount of road as Alternative 3. Under this alternative, 10.0 miles of road would be closed year round (more than Alternative 2) and 5.7 miles closed seasonally (less than Alternative 2) to partially compensate for cover lost through vegetative treatment activities. These closures would improve post-treatment elk habitat to some degree by reducing potential disturbance associated with motorized vehicle use in winter range and summer range/general forest. This alternative would utilize 2.0 fewer miles of closed roads (51.5 miles total) and the same mileage of existing temporary road (5.4 miles) when compared to Alternative 3. There would be no new temporary road construction under this alternative. As a result, the direct and indirect effects on elk resulting from road use and potential non-permitted OHV use would be least under this alternative.

The road proximity analysis indicates that Alternative 4 would provide more acres of satisfactory cover in the C3 Management Area that are greater than 0.5 miles from an open road, when compared to the other action alternatives. Alternative 4 would also provide more acres of marginal cover greater than 0.5 miles from an open road than both of the other action alternatives. Please refer to Tables W-11, W-12, and W-13 for specifics regarding the road proximity assessment. Alternative 4 would provide fewer acres of forage distant from open roads due to the fact that it would retain more acres of cover in these areas. As a result, the expected impacts to elk habitat and elk distribution would likely be less than those expected under Alternatives 2 and 3.

When the impacts to cover habitat, HEI, the road system, and security habitat are combined, Alternative 4 would have the least impact on elk and their habitat when compared to the other action alternatives. Alternative 4 would provide larger patches of cover distributed across the landscape, generally result in more acres of security habitat (cover and forage) being available, maintain cover habitat in all RHCAs and inaccessible areas (requiring temporary roads), and reduce disturbance to a slightly greater degree than would Alternative 3. Reductions in cover availability, security habitat (cover), and the availability of spring and summer forage would likely impact the distribution of elk. In the late winter, spring, and early summer, the improvement in the quality and quantity of forage resulting from vegetative treatment and burning and seasonal closure of roads in C3 winter range would improve elk distribution and may pull elk off of adjacent private lands. Elk would likely be concentrated in and around untreated cover stands and riparian areas where green, nutritious forage is present in the late summer. The greater availability of cover stands under this alternative would provide more area than Alternatives 2 and 3 in terms of hiding and escape cover. It is feasible that the amount of cover retained in this alternative may reduce the likelihood that elk would spend a greater proportion of their time, and longer periods of time, on private lands adjacent to the Forest, or on NFS lands adjacent to the Kahler Project area.

Alternative 4 would require a site-specific Forest Plan amendment to treat cover habitat in the E1 (West) and C3 management areas. In the C3 management area, the total cover, satisfactory cover, and HEI standards would be amended to the post treatment levels of 13.2%, 1.4%, and 58 for the duration of the Kahler Project. In the E1 (West) management area, the HEI standard would be amended to the post treatment level of 29 for the duration of the Kahler Project. The direct and indirect effect of the amendment is that elk habitat quality would be reduced further below existing Forest Plan standards, with consequent changes in elk distribution.

Cumulative Effects

The cumulative effects of this alternative on elk and elk habitat would be similar to those described under *Common to All Action Alternatives*. When the expected effects of Alternative 4 are combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be an incremental reduction in cover that would add to past reductions in the analysis area resulting from timber harvest, wildfire, and other activities. The expected impacts to elk cover, elk vulnerability, and elk distribution are expected to be less under this alternative than Alternatives 2 and 3. While elk may still move off NFS lands (or at least out of the project area) during high disturbance periods, the retention of more cover distributed across the landscape would provide for areas where elk could feel secure during high use periods like hunting season. These movements may be less frequent or shorter in duration than would be expected under Alternatives 2 and 3.

Forest Plan Consistency

Because Alternative 4 would reduce cover habitat for elk, the overall direct, indirect and cumulative effects would result in a negative habitat trend at the Forest scale. At the Forest scale, cumulative impacts associated with implementation of Alternative 4 would not result in short or long term population reductions due to the size of the affected area. While this alternative would require a Forest Plan amendment, it would provide for a relatively high level of HEI in the C3 and E1 (East) management areas, and would contribute toward meeting the numerical management objectives of the Oregon Department of Fish and Wildlife, which are well in excess of minimum viable populations. Thus, the continued viability of elk is expected on the Umatilla National Forest, and hunting opportunities will be available at similar levels to those currently available in the Heppner and Fossil Management Units. The Forest Plan would be amended to permit treatment of satisfactory and marginal cover and to reduce HEI. This would be consistent with the overall goals of the E1 management area, which are to emphasize production of wood fiber (timber) and encourage forage production (USDA 1990, pg 4-178). This alternative would also be consistent with the goals of the C3 management area, which are to provide high levels of potential habitat effectiveness and high quality forage for big game species.

PRIMARY CAVITY EXCAVATORS

AFFECTED ENVIRONMENT

Primary cavity excavators (PCE) include bird species that create holes for nesting or roosting in live, dead, or decaying trees. The Primary Cavity Excavator group plays an important ecological role by excavating nest cavities that are later used by other birds and small mammals (including owls, bluebirds, flying squirrels, and others) for denning, roosting, and/or nesting. Thomas (1979) indicates that 62 species use cavities created by cavity excavating birds in the Blue Mountains of Oregon. More than 80 species of birds, mammals, reptiles, and amphibians in the interior Columbia River basin use living trees with decay features, hollow trees, trees with brooms and dead tops, and dead trees (snags) for nesting, roosting, denning, and foraging (Bull et al. 1997, Wisdom et al. 2000). As standing snags decay, they fall to the ground, provide food and shelter for other wildlife species, and contribute to nutrient cycling in forested ecosystems (Johnson and O'Neil 2001). Cavity excavators may also play a role in hastening decomposition of woody material by spreading wood-decay fungi more readily than other media (Farris et al. 2004). Thomas identifies species that excavate cavities in dead wood in his *Wildlife Habitats in Managed Forests of the Blue Mountains of Oregon and Washington* (Thomas 1979, Appendix 20). These species include the Black-backed woodpecker, Downy woodpecker, Hairy woodpecker, Lewis's woodpecker, Northern flicker, American three-toed woodpecker, Pygmy nuthatch, Red-breasted nuthatch, Red-naped sapsucker, White-breasted nuthatch, White-headed woodpecker, Williamson's sapsucker, Pileated woodpecker, Black-capped chickadee, Mountain chickadee, Chestnut-backed chickadee, and others (Thomas 1979).

The Primary Cavity Excavator group (not individual species of cavity excavating birds) was selected as MIS to be an indicator of dead/down tree (snag) habitat on the Forest. It is assumed that if dead wood (snag) habitat is provided for the Primary Cavity Excavator group, that adequate habitat is also being provided for species that require cavities for some portion of their life cycle. Habitat for these species consists of dead and downed wood features in numerous structural stages and compositions, ranging from post-fire stands, to open juniper and ponderosa pine woodlands, and at the highest elevations subalpine fir and Engelmann spruce forest. Primary cavity excavators typically feed on forest insects, and can regulate populations of these tree-feeding insects.

Declines in densities of large snags (>21" dbh) is a common threat to the cavity nesting group of MIS (Wisdom et al. 2000). Based on past literature describing dead wood dynamics in the Columbia River basin, expert opinion, and modeling, Korol and others (2002) compared existing dead wood data in the basin to historic estimates of dead wood for a number of different structural stages, vegetation types, and fire regimes. Korol and others (2002) found that basin-wide, the abundance of small snags decreased 14 percent when compared to historical conditions; on Forest Service and Bureau of Land Management administered lands, small snag densities actually increased by 7% from historic conditions. Korol and others (2002) also found that the abundance of large snags decreased both basin-wide (-31%) and on Forest Service and Bureau of Land Management administered lands (-8%) when compared to historic conditions, with most losses occurring in the Dry and Moist Forest PVGs due to decreases in late-seral forests. These losses were compounded in managed areas and roaded areas by past harvest and fuelwood cutting. Specific threats are listed in Table W-14 below.

Table W-14. Threats to individual primary cavity excavating birds species.

Species	Threats	Citations
Black-backed woodpecker	Removal of fire-killed or insect-infested trees, altered frequency of stand-replacing fire, decline in availability of medium to large snags infected with heart rot.	Wisdom et al. 2000, NatureServe 2014
Downy woodpecker	Replacement of hardwood habitat with coniferous habitats.	Marshall et al. 2003
Hairy woodpecker	House sparrows usurping nests	NatureServe 2014
Lewis's woodpecker	Loss of large pines and cottonwoods, loss of large, soft snags; fire suppression resulting in ponderosa pine being replaced by Douglas-fir and grand fir-white fir; and potential loss of remaining large pines due to fire. Reduced shrub cover due to fire suppression and grazing. Overgrazing in riparian habitats. Negative impacts from agricultural pesticides.	Wisdom et al. 2000, NatureServe 2014
Northern flicker	Loss of large soft to moderate snags.	Marshall et al. 2003
American three-toed woodpecker	Decline in late-seral subalpine and montane forests, especially Engelmann spruce-subalpine fir. Removal of fire-killed or insect-infested trees, altered frequency of stand-replacing fire, decline in availability of medium to large snags infected with heart rot.	Wisdom et al. 2000, NatureServe 2014

Species	Threats	Citations
Pygmy nuthatch	Habitat degradation: Loss of large pines, loss of large snags; fire suppression resulting in ponderosa pine being replaced by Douglas-fir and grand fir-white fir; and potential loss of remaining large pines due to fire.	Wisdom et al. 2000
Red-breasted nuthatch	Loss of snags and structural diversity.	Marshall et al. 2003
Red-breasted sapsucker	Loss of larger snags and old forest.	Marshall et al. 2003
Red-naped sapsucker	Loss of large aspen snags and trees.	Marshall et al. 2003
White-breasted nuthatch	Habitat degradation: Loss of large pines, loss of large snags; fire suppression resulting in ponderosa pine being replaced by Douglas-fir and grand fir-white fir; and potential loss of remaining large pines due to fire. Decline in old stands of aspen and cottonwood. .Loss of open stands of large diameter oaks.	Wisdom et al. 2000, Marshall et al. 2003
White-headed woodpecker	Habitat degradation: Loss of large pines, loss of large snags; fire suppression resulting in ponderosa pine being replaced by Douglas-fir and grand fir-white fir; and potential loss of remaining large pines due to fire.	Wisdom et al. 2000, NatureServe 2014
Williamson's sapsucker	Reduction in late-seral forest habitat, reduction in numbers of large snags	Wisdom et al. 2000

The conservation status of a species is an indicator of the likelihood of that species continuing to survive either in the present day or the future. On the Umatilla National Forest, Primary Cavity Excavators (as a group) are Management Indicators for dead and downed wood (snag) habitat. As a group, primary cavity excavators are not Region 6 Sensitive, US Fish and Wildlife Service Birds of Conservation Concern, or listed as Sensitive by the State of Oregon. Individual cavity excavators are present on these lists. Table W-15 below shows the conservation status of a number of cavity excavators with the potential to occur on the Umatilla.

Table W-15. Conservation status of selected cavity nesting bird species with a potential to occur on the Umatilla National Forest.

Species	USFS Sensitive – Region 6	NatureServe Ranks[1]		USFWS Birds of Conservation Concern[2]	ODFW[3]
		Global	OR		
Black-backed woodpecker		G5	S3		Vulnerable
Downy woodpecker		G5	S4		
Hairy		G5	S4		

woodpecker					
Lewis's woodpecker	Yes	G4	S2S3	Yes, BCR 10	Critical
Northern flicker		G5	S5		
American three-toed woodpecker		G5	S3		Vulnerable
Pygmy nuthatch		G5	S4		
Red-breasted nuthatch		G5	S5		
Red-naped sapsucker		G5	S4		
White-breasted nuthatch		G5	S4		
White-headed woodpecker	Yes	G4	S2S3	Yes, BCR 10	Critical
Williamson's sapsucker		G5	S4B S3N	Yes, BCR 10	

[1] NatureServe Ranks: NatureServe 2014, available at http://www.natureserve.org/explorer/

- G5 or S5 – Widespread, abundant, secure
- G4 or S4 – Apparently secure
- G3 or S3 – Vulnerable
- G2 or S2 – Imperiled

[2] Species of Concern in any BCR (Bird Conservation Region) Listed (USFWS 2008); BCR 10 = Northern Rocky Mountains

[3] Oregon Department of Fish and Wildlife Sensitive Species (ODFW 2008) (http://www.dfw.state.or.us/wildlife/diversity/species/docs/SSL_by_taxon.pdf)

Available population trend data is presented in Table W-16 below for selected species of cavity excavating birds. Population trends were determined by using data and analyses from the North American Breeding Bird Survey Project (Sauer et al. 2011- *http://www.mbr-pwrc.usgs.gov/bbs/bbs.html*). The breeding bird survey (BBS) is a large-scale, long-term survey of North American birds that provides an index of population abundance that can be used to estimate population trends and relative abundance at various geographic scales.

Table W-16. Population trend data for selected cavity nesting bird species with a potential to occur on the Umatilla National Forest.

	Breeding Bird Survey Database[1]	
Species	**Oregon Trend**	**Reliability Rating**
Black-backed	stable	yellow

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woodpecker		
Downy woodpecker	stable	yellow
Hairy woodpecker	stable	blue
Lewis's woodpecker	no trend	red
Northern flicker	decrease	blue
American three-toed woodpecker	no data	no data
Pygmy nuthatch	stable	yellow
Red-breasted nuthatch	stable	blue
Red-naped sapsucker	no trend	yellow
White-breasted nuthatch	stable	yellow
White-headed woodpecker	stable	yellow
Williamson's sapsucker	stable	blue

[1] Breeding Bird Survey (Sauer et al. 2011) - (http://www.mbr-pwrc.usgs.gov/bbs/cred.html)

- Increase = significant ($p<0.05$) increase from 1966-2010
- Decrease = significant ($p<0.05$) increase from 1966-2010
- Stable = yellow or blue reliability and no significant increase or decrease
- No trend = red reliability and no significant increase or decrease

Source Habitats for Terrestrial Vertebrates of Focus in the Interior Columbia Basin: Broad-Scale Trends and Management Implications (Wisdom et al. 2000) provides valuable information on habitat trends in the Columbia Basin. Wisdom et al. (2000) defined habitat requirements (source habitats) and assessed broad-scale trends of 91 species of terrestrial vertebrates within the Interior Columbia Basin in conjunction with the Interior Columbia Basin Ecosystem Management Project, including a number of primary cavity excavators. Source habitats are defined as those characteristics of macro-vegetation (vegetation that can be measured accurately using 100 hectare [247 acres] pixel) that contribute to stationary or positive population growth for a species in a specified area and time and to long-term population persistence. Source habitats contribute to source environments, which represent the composite of all environmental conditions that result in stationary or positive population growth for a species in a specified area and time. Source habitats are distinguished from habitats simply associated with species occurrence; species occurrence by itself does little to indicate the capability of the environment to support long-term persistence of populations (Wisdom et al. 2000). Table W-17 shows the relative change and trend in source habitat for selected primary cavity excavators. The assessment process that was used by the ICBEMP and forest plan revisions is based on using the concept of Historic Range of Variability (HRV) to assess likelihood of maintaining viable populations of species. By managing habitat within HRV it is assumed that adequate habitat will be provided because species survived those levels of habitat in the past to be present today (Haufler et al. 1996, Agee 2002). Thus, if current habitats are managed within the range of historic variability, we will likely do an adequate job of ensuring population viability for those species that remain (Landres et al. 1999).

Table W-17. The relative change in habitat and trend category in the Blue Mountains Ecological Reporting Unit (ERU) (Wisdom et al. 2000; Table 5).

Relative change calculation is explained on page 33, Vol 1 (Wisdom et al. 2000).

Species	Group (Wisdom et al. 2000)	Blue Mountains ERU Relative Change & Trend Category	Reference Page Numbers
Black-backed woodpecker	9	-30.96 Decreasing	209-215; 497
Lewis's woodpecker	2	-72.17 Strongly decreasing	166-172; 491
American three-toed woodpecker	11	100+ Strongly increasing	219-224; 498
Pygmy nuthatch	1	-79.78 Strongly decreasing	161-166; 491
White-breasted nuthatch	1	-27.57 Decreasing	161-166; 491
White-headed woodpecker	1	-79.26 Strongly decreasing	161-166; 491
Williamson's sapsucker	6	-37.96 Decreasing	190-199; 494

The existing snag density distribution for various habitat types (described in DecAID) at the analysis area and Forest scale was estimated using Gradient Nearest Neighbor (GNN) modeling (Ohmann and Gregory 2002). Refer to the website www.fsl.orst.edu/lemma for more information on the GNN modeling process. The existing condition in the Kahler analysis area and the Umatilla National Forest as a whole is compared with the historic distribution of snags (based on information provided by the DecAID Advisor) below. This analysis is intended to be a course level analysis of snag density and distribution within the Kahler analysis area. The snag analysis area for the Kahler Project includes Forest Service land within the Kahler Creek-John Day River, Upper Rock Creek, and Wall Creek watersheds, an area of approximately 503,281 acres, of which approximately 142,239 acres occur on National Forest System lands. Analysis at this scale provides statistically valid estimates of snag densities. Snags occur as scattered singles, clumps, and/or patches resulting in variable densities (including stands with zero snags) across the landscape. The Forest Plan established standards for snag density based on the population requirements of species associated with snags. The plan was amended in 1995 by the Regional Forester's Forest Plan Amendment #2 (USDA 1995), also known as the "Eastside Screens." Existing average snag density information for the Kahler analysis area was derived from Current Vegetation Survey (CVS) plots. Existing snag densities (average) for the Kahler analysis area are found in Table W-18 below.

Table W-18. Existing Conditions (CVS Plot Estimates) and Forest Plan Standards for Snag Density in the Kahler Analysis Area (Kahler Creek-John Day River, Upper Rock Creek, and Wall Creek Watersheds).

Umatilla Forest Plan Standards (USDA 1996)			Kahler-John Day River, Upper Rock, and Wall Watersheds, combined		
Working	**Diameter Class**	**Snag Density**	**DecAID Forest**	**Diameter Class**	**Snag Density**

Group	Groups (Inches DBH)	(#/acre)	Type	Groups (Inches DBH)	(#/acre)
Ponderosa Pine	> 10	2.25	Ponderosa Pine/Douglas-fir Forest	> 10	8.4
	> 20	0.14		> 20	1.4
Mixed Conifer	> 10	2.25	Eastside Mixed Conifer/ Blue Mountains Forest	> 10	47.3
	> 20	0.14		> 20	8.0

Based on CVS data in the snag analysis area, average snag densities exceed Forest Plan standards in all diameter classes for the Ponderosa pine/Douglas-fir and Eastside Mixed Conifer/Blue Mountains forest types (Table W-18). By meeting the Forest Plan standards for snag density in these habitat types, the Kahler analysis area is providing structural habitat features desired by a number of primary cavity excavating species and other wildlife. While average snag densities meet the amended Forest Plan standard for snag density, it should be noted that a wide range of snag densities are present in the Kahler Creek-John Day River, Upper Rock Creek, and Wall Creek watersheds and the project area. A number of the CVS plots had no measurable snags, largely due to past harvest, wildfire, wood cutting, and the natural growing potential/snag dynamics on some sites. Mellen-McLean and others (2012) state that some level of habitat with no snags is not unexpected based on historic information. It should also be pointed out that inclusion of the Wall Creek Watershed in the snag analysis area resulted in much higher average snag densities for the Eastside Mixed Conifer/ Blue Mountains Forest DecAID Habitat Type than those in the Kahler Creek-John Day River and Upper Rock Creek Watersheds. Without inclusion of the Wall Creek Watershed, snag densities in this habitat type were 11.1 and 2.9 snags per acre in the >10 and >20 inch diameter groups, respectively. This is likely due to the fact that mixed conifer stands in the Wall Creek watershed were impacted heavily by spruce budworm in the 1980s and early 1990s, resulting in very high snag densities in these stands; subsequent (and ongoing) fuels treatments under the Wildcat II EA have reduced these snag and dead wood densities, but these changes are not reflected in CVS data used here. The Monument Complex Fire (2007) and Sunflower Fire (2014) also impacted portions of the snag analysis area, creating burned high density snag "forests" desired by some primary cavity excavating species (black-backed, three-toed woodpeckers, etc.). Snag densities in Table W-18 do not reflect snags created by these fires due to the fact that CVS plots have not been re-measured since they occurred. Approximately 7,525 acres burned at high and moderate severity in the Monument Complex Fire; an additional 950 acres within the Sunflower Fire burned at high and moderate severity. This fire is the most recent large fire to occur in the analysis area. Burned areas in the Wheeler Point Fire (1996) were extensively salvaged; unsalvaged areas no longer provide high snag density patches due to decay.

Current Forest Plan standards for snag retention are based on the biological (population) potential model described in Thomas and others (1979). The goal of management for species richness is to insure that most native wildlife species are maintained in viable numbers and that habitat requirements for all species must be accounted for (Thomas, 1979, p.141). Habitat requirements, including snag and down woody material levels, were described for a vast array of wildlife species using information known at the time in Thomas (1979). However, Bull et al. (1997) states that current direction for providing wildlife habitat on public forest lands does not reflect the new information available, which suggests that to fully meet the needs of wildlife, additional snags and habitat are required for foraging, denning, nesting, and roosting. Rose et al. (2001) suggests that calculation of numbers of snags required by woodpeckers based on assessing their "biological (population) potential" is a flawed technique (Rose et al., 2001) due to the fact that empirical studies are suggesting that snag numbers in areas used and selected by some wildlife species are far higher than those calculated by this technique. There is general consensus that the biological potential model does not provide adequate nesting, roosting, or foraging structure for cavity excavating birds (Bull et al. 1997, Johnson and O'Neil 2001). This suggests the current direction of managing for 100 percent population levels of primary excavators may not represent the most current knowledge of managing for cavity nesters.

DECAYED WOOD ADVISOR (DECAID)

In 2003, the Decayed Wood Advisor (Mellen-McLean et al. 2012) became available to aid managers in their analyses of dead wood habitat. DecAID provides information and guidance to land managers in evaluating effects of forest management activities on organisms that use dead standing wood (snags), downed wood, and other wood decay elements. DecAID was used to assist with the analysis of effects on snag dependent wildlife species by providing a thorough review of published literature and other available data on wildlife use of decayed wood elements, a statistical synthesis of data showing levels of use by individual wildlife species of decayed wood elements (tolerance levels), a summary of the patterns of use of decayed wood elements by wildlife species in Oregon and Washington, and an approximation of historic snag density distribution in various habitat types. DecAID was not used as a wildlife population simulator, to analyze population viability, or used as a substitute for making decisions based on professional experience. Data provided in DecAID allows the user to relate the abundance of deadwood habitat for both snags and down logs to the frequency of occurrence of selected wildlife species that require deadwood habitat for some part of their life cycle. This data is presented at 30%, 50%, and 80%"tolerance levels." These levels are derived from and combined for one or more published studies of the species in question. Tolerance intervals are estimates of the percent of all individuals in the population that are within some specified range of values. The 80% tolerance level indicates that 80% of the individuals in the population have a value for the parameter of interest (e.g. snag density) between zero and the value for the 80% tolerance level. For example, an 80% tolerance level for snag density (snags/acre) means that 80% of all individuals observed of some species used snag densities less than or equal to some specific snag density level; the remaining 20% of all individuals would use snag densities higher than the 80% level (Mellen-McLean et al. 2012). Areas meeting or exceeding the 80% tolerance level generally represent snag pulses created by wildfire or insect and disease events. Tolerance levels are not indicators of population viability, "thresholds", or potential populations; nor are they meant to be used as standards for a particular vegetation type and species.

There are limitations to information contained in the DecAID Advisor. These limitations are summarized in the *Caveats and Cautions* link on the DecAID website (Mellen-McLean et al. 2012). This document is available in the project file. Several key limitations to the DecAID Advisor include:

- DecAID is not a simulation model or population viability model.
- Users must understand the underlying data and determine whether data is appropriate for the local situation.
- DecAID does not necessarily account for all species uses of dead wood (nesting,

foraging, roosting, etc.), or the value of all decadence/decay elements.
- Depending on the location (nest site or other) and methods of data collection, the information contained in DecAID may provide a better approximation of dead wood components in higher density clumps than the stand or landscape average of snag and downed wood sizes and amounts.
- Data displayed on the cumulative species curves (tolerance levels) may be skewed higher due to the location where measurements of dead wood were taken.
- Combining data across studies done at different scales (plot sizes) and habitat parameters can lead to variability and potential error (inflation) in the data. Tests for common problems were not significant.
- Data from empirical studies may be biased.
- Past management (fire suppression and management) may impact the inventory plot data used to estimate historic dead wood conditions. Use of other published estimates for historic conditions are encouraged.

Two of the DecAID wildlife habitat types are well represented in the Kahler analysis area. They include Ponderosa Pine/Douglas-fir forest and Eastside Mixed Conifer/Blue Mountains forest. The Ponderosa Pine/Douglas-fir DecAID habitat type coincides well with the dry upland forest PVG. The Eastside Mixed Conifer/Blue Mountains DecAID habitat type includes stands in both the dry upland and moist upland forest PVGs. Information regarding the dead wood preferences of those cavity excavating species represented in the DecAID Advisor is presented below. Tables W-19 and W-20 display snag densities surrounding nest and/or roost sites of some primary cavity excavating birds in the Ponderosa Pine and Eastside Mixed Conifer DecAID habitat types. Snag densities are from the Small/Medium and Larger Tree Structural Condition Classes (Mellen-McLean et al. 2012).

Table W-19. DecAID Tolerance Levels for Ponderosa Pine/Douglas-fir (PPDF) Forest Associated Primary Cavity Excavator Species.

	Snag density/acre for 30%, 50%, 80% tolerance levels			
	Green Forests		Recent Post-fire[1]	
Species	**>10" dbh**	**>20" dbh**	**>10" dbh**	**>20" dbh**
Black-backed woodpecker	2.5, 13.6, 29.2	0.0, 1.4, 5.7	37.4, 52.8, 76.5	
Hairy woodpecker			39.2, 63.3, 100.0	
Lewis's woodpecker			24.7, 42.7, 70.6	0.0, 6.2, 16.1
Northern flicker			25.0, 44.9, 83.1	2.2, 17.4, 39.6
Pygmy nuthatch	1.1, 5.6, 12.1	0.0, 1.6, 4.0		
White-headed woodpecker	0.0, 3.9, 11.9	0.5, 1.8, 3.8	22.2, 40.9, 68.3	
Williamson's sapsucker	14.0, 28.4, 49.7	3.0, 8.4, 16.3		

[1]Existing data for post-fire stands is not available for the Kahler Analysis Area; therefore, snag habitat in post-fire environments will not be analyzed. No activities would occur in post-fire habitat.

Table W-20. DecAID Tolerance Levels for Eastside Mixed Conifer/Blue Mountains (EMC_ECB) Forest Associated Primary Cavity Excavator Species.

Species	Snag density/acre for 30%, 50%, 80% tolerance levels			
	Green Forests		Recent Post-fire[1]	
	>10" dbh	>20" dbh	>10" dbh	>20" dbh
Black-backed woodpecker	2.5, 13.6, 29.2	0.0, 1.4, 5.7	57.2, 82.4, 119.2	
Hairy woodpecker			42.9, 67.2, 104.1	
Lewis's woodpecker			24.2, 39.5, 62.8	0.0, 6.2, 16.1
Northern flicker			26.8, 49.6, 84.1	2.2, 17.4, 39.6
Pygmy nuthatch	1.1, 5.6, 12.1	0.0, 1.6, 4.0		
White-headed woodpecker	0.3, 1.9, 4.3	0.0, 1.5, 3.8	18.6, 52.0, 98.7	
Williamson's sapsucker	14.0, 28.4, 49.7	3.3, 8.6, 16.6		

[1]Existing data for post-fire stands is not available for the Kahler Analysis Area; therefore, snag habitat in post-fire environments will not be analyzed. No activities would occur in post-fire habitat.

It should be noted that tolerance levels calculated for the Ponderosa pine/Douglas-fir and Eastside Mixed Conifer/Blue Mountains habitat types were derived from plots centered on nest sites, which typically occur in locations with more dead wood than the average available. As a result, these data may provide a better approximation of dead wood components in higher density clumps than the stand or landscape average of snag amounts (densities).

The distribution of snags in unharvested plots in DecAID (Mellen-McLean et al. 2012) is used as a surrogate to represent the potential "historic" distribution of snags. It is noted in DecAID that caution must be used when using unharvested plot data as a surrogate for describing the historic condition in forested habitats on the east side of Oregon. These unharvested plots may have been impacted by past management activities. In some areas, dead wood levels may be elevated due to increased mortality resulting from fire suppression, while in others, snag densities may be depleted below historic conditions due to intense fire or fuelwood cutting. Refer to the DecAID Implementation Guide *Comparison of Historical Range of Variability for Dead Wood: DecAID vs. Other Published Estimates* (Mellen-McLean et al. 2012b) for a description of historic snag density estimates derived from recent literature for the Ponderosa Pine/Douglas-fir and Eastside Mixed Conifer/Blue Mountains forest types. Due to the fact that estimates derived from literature and DecAID are similar (overlapping), DecAID inventory data is expected to provide a reasonable estimate of historic conditions in these habitat types. Snag density distributions approximating the historic reference conditions in the Ponderosa Pine/Douglas-fir Forest and Eastside Mixed Conifer/Blue Mountains Forest Habitat Types are displayed in Figures W-03, W-04, W-05, and W-06. Data for the small/medium, large, and open structure classes have been weighted based on the historic reference condition for structure and combined to provide an approximation of the HRV for each of these habitat types. DecAID vegetation data provide the most current scientific data available and it is the only data that indicates the historical distribution of snag densities.

Figures W-03 and W-04 below compare the current distribution of snags on the Umatilla National Forest and the Kahler analysis area with the unharvested (reference) distribution of snags for the Ponderosa Pine/Douglas-fir (PPDF) Habitat type in DecAID.

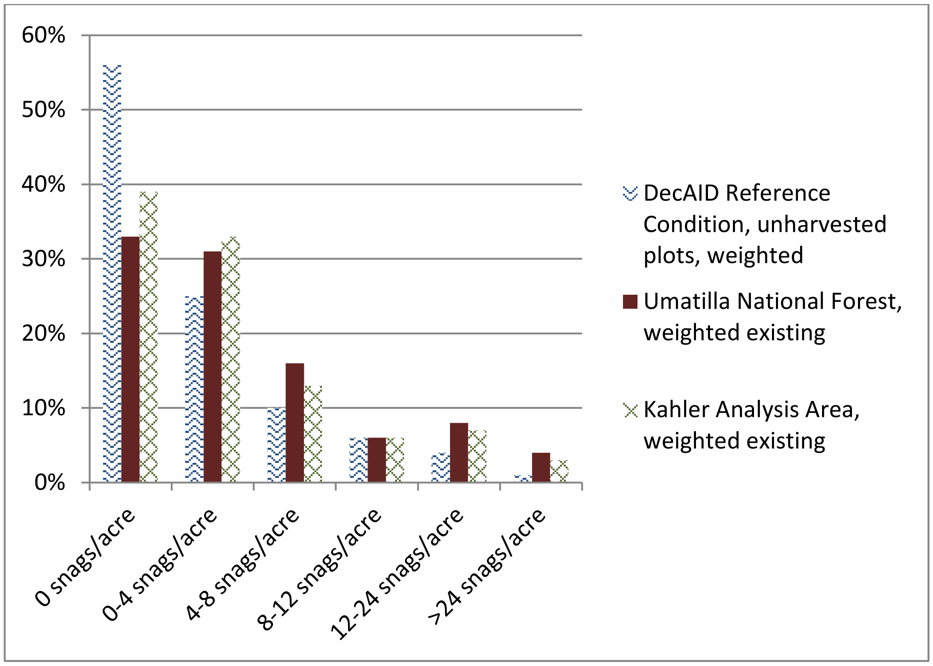

Figure W-03. Distribution of snags (% of the area) ≥10 inches DBH in the PPDF habitat type for the DecAID Reference Condition, the Umatilla National Forest, and the Kahler Analysis Area.

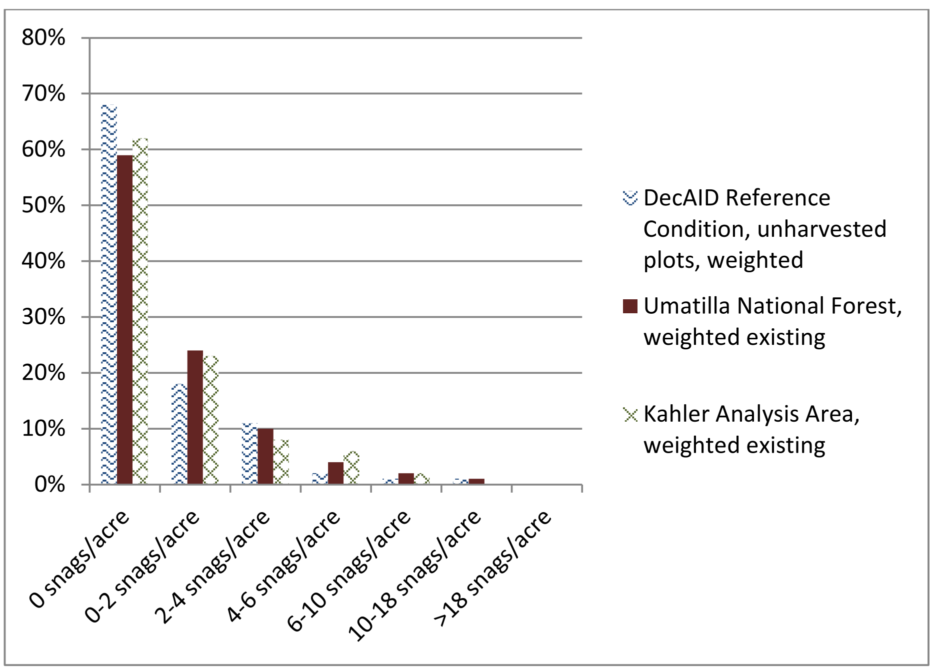

Figure W-04. Distribution of snags (% of the area) ≥20 inches DBH in the PPDF habitat type for the DecAID Reference Condition, the Umatilla National Forest, and the Kahler analysis area.

Examination of Figures W-03 and W-04 shows that the existing distribution of snags in the Kahler analysis area and the Umatilla National Forest resemble the DecAID reference distributions for the PPDF habitat type, but that there are distinct differences in some cases. DecAID indicates that 56% and 68% (weighted average of open, small/medium, and large structural classes for the ≥10 and ≥20 inch groups, respectively) of PPDF habitat had zero snags under the reference condition; in the Kahler analysis area, 39% and 62% (weighted average of open, small/medium, and large structural classes for ≥10 and ≥20 inch groups, respectively) of PPDF habitat currently has zero snags. A similar condition (33% and 59% in the ≥10 and ≥20 inch groups, respectively) exists for the Umatilla National Forest as a whole when compared to the DecAID reference condition. In both the ≥10 and ≥20 inch groups, there is more area in the Kahler analysis area and on the Umatilla that currently has zero to 4 and zero to 2 snags/acre than is expected under the reference condition, respectively. There is also more area in the upper range of the distribution (the 4-8, 12-24 and >24 snags/acre groups) for the ≥10 inch diameter group in the Kahler area and Umatilla than would be expected to occur under the reference condition.

Based on the current distribution of snags ≥10 inches dbh in the Kahler analysis area, approximately 26% of the PPDF habitat within the analysis area provides snag densities that exceed the 80% tolerance level for this habitat type (weighted average of 80% tolerance level = 4.7 snags/acre based on PPDF_O.inv-2, PPDF_S.inv-2, and PPDF_L.inv-2 in DecAID (Mellen-McLean et al. 2012)). At the scale of the Umatilla National Forest, 33% of the PPDF habitat in the ≥10 inch dbh group provides snag densities that exceed this 80% tolerance level for this habitat type. DecAID indicates that approximately 20% of the landscape in these structural stages would meet or exceed this 80% tolerance level under the reference condition.

Based on the current distribution of snags ≥20 inches dbh in the Kahler analysis area, at least 25% of the PPDF habitat within the analysis area provides snag densities that exceed the 80% tolerance level for this habitat type (weighted average of 80% tolerance level = 1.0 snags/acre based on PPDF_O.inv-3, PPDF_S.inv-3, and PPDF_L.inv-3 in DecAID (Mellen-McLean et al. 2012)). At the scale of the Umatilla National Forest, at least 29% of the PPDF habitat in the ≥20 inch dbh group provides snag densities that exceed this 80% tolerance level for this habitat type. DecAID indicates that approximately 24% of the landscape in these structural stages would meet or exceed this 80% tolerance level under the reference condition.

This data indicates that snag habitat in the PPDF habitat type for the ≥10 and ≥20 inch groups at the Forest and Kahler analysis area scales resembles the historic snag density distribution for this habitat type, provides high density snag patches at similar or greater proportions than the reference condition, and is contributing toward the viability of the primary cavity excavator group at the Forest scale.

Figures W-05 and W-06 below compare the current distribution of snags on the Umatilla National Forest and the Kahler analysis area with the unharvested (reference) distribution of snags for the Eastside Mixed Conifer/Blue Mountains (EMC_ECB) Habitat type in DecAID.

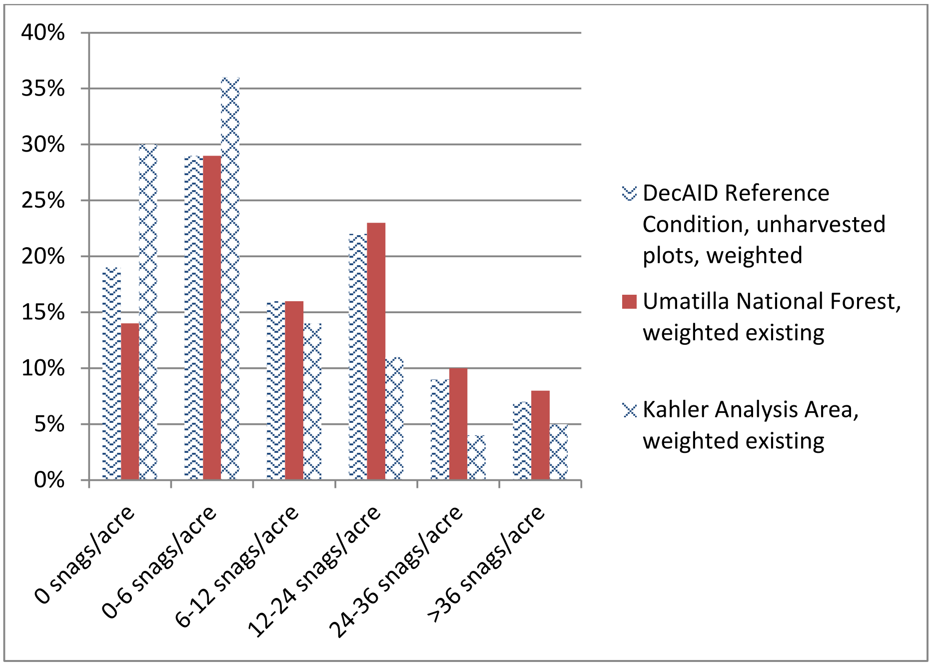

Figure W-05. Distribution of snags (% of the area) ≥10 inches DBH in the EMC/Blue Mountains habitat type for the DecAID Reference Condition, the Umatilla National Forest, and the Kahler Analysis Area.

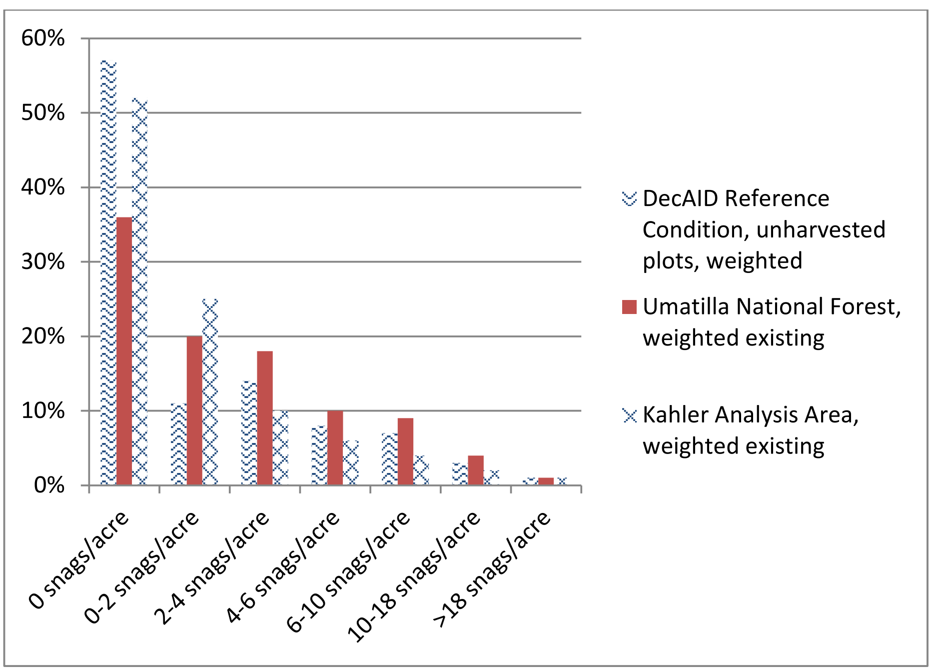

Figure W-06. Distribution of snags (% of the area) ≥20 inches DBH in the EMC/Blue Mountains habitat type for the DecAID Reference Condition, the Umatilla National Forest, and the Kahler Analysis Area.

Examination of Figures W-05 and W-06 shows that the existing distribution of snags in the Kahler analysis area and the Umatilla National Forest resemble the DecAID reference distributions for the EMC/Blue Mountains habitat type, but that there are distinct differences in some cases. DecAID indicates that 19% and 57% (weighted average for the ≥10 and ≥20 inch groups, respectively) of EMC/Blue Mountains habitat had zero snags under the reference condition; in the Kahler analysis area, 30% and 52% (≥10 and ≥20 inch groups, respectively) of EMC/Blue Mountains habitat currently has zero snags. In the ≥10 inch group, there is also more area in the Kahler Analysis Area (36%) that currently has zero to 6 snags/acre than would be expected under the reference condition. There is also currently less area (21% combined) in the Kahler analysis area that provides 12-24, 24-36, and >36 snags per acre than would be expected under the reference condition. In the ≥20 inch group, there is over twice as much area with zero to 2 snags/acre than would be expected under the reference condition. Conversely, there is less are than expected under the reference condition in the 2-4, 4-6, and 6-10 snags per acre groups.

Based on the current distribution of snags ≥10 inches dbh in the Kahler analysis area, approximately 12% of the EMC_ECB (Blue Mountains) habitat within the analysis area provides snag densities that exceed the 80% tolerance level for this habitat type (weighted average of 80% tolerance level = 20.3 snags/acre based on EMC_ECB_O.inv-2, EMC_ECB_S.inv-2, and EMC_ECB_L.inv-2 in DecAID (Mellen-McLean et al. 2012)). At the scale of the Umatilla National Forest, 25% of the EMC_ECB habitat in the ≥10 inch dbh group provides snag densities that exceed this 80% tolerance level for this habitat type. DecAID indicates that approximately 23% of the landscape in these structural stages would meet or exceed this 80% tolerance level under the reference condition.

Based on the current distribution of snags ≥20 inches dbh in the Kahler analysis area, 7% of the EMC_ECB habitat within the analysis area provides snag densities that exceed the 80% tolerance level for this habitat type (weighted average of 80% tolerance level = 6.3 snags/acre based on EMC_ECB_O.inv-3, EMC_ECB_S.inv-3, and EMC_ECB_L.inv-3 in DecAID (Mellen-McLean et al. 2012)). At the scale of the Umatilla National Forest, 14% of the EMC_ECB habitat in the ≥20 inch dbh group provides snag densities that exceed this 80% tolerance level for this habitat type. DecAID indicates that 11% of the landscape in these structural stages would meet or exceed this 80% tolerance level under the reference condition.

This data indicates that snag habitat in the EMC_ECB habitat type for the ≥10 and ≥20 inch groups at the Forest and Kahler analysis area scales resembles historic snag density distributions (with some deviations), provides high density snag patches at similar proportions as the reference condition, and is contributing toward the viability of the primary cavity excavator group at the Forest scale.

Tables W-21 and W-22 display the amount of the Kahler analysis area that currently provides habitat for selected species (those with wildlife tolerance level data available in DecAID for green forest habitat) that meets the tolerance levels (30%, 50%, and 80%) identified in DecAID for these species. This data was developed using the snag density distributions calculated from the existing condition in the Kahler Analysis Area for snags ≥10 and ≥20 inches dbh. This data was compared to wildlife tolerance level data to calculate the percentage of the analysis area meeting individual tolerance levels for those species listed.

Table W-21. Percent of the PPDF Forest Habitat within the Kahler Analysis Area and the DecAID reference condition that meets tolerance levels described in DecAID for cavity excavating species in the ≥10 and ≥20 inch groups.

	Snags >10" dbh				Snags >20" dbh			
	0-30%	30-50%	50-80%	80+%	0-30%	30-50%	50-80%	80+%
Species	Percent of Area (*Kahler*/**DecAID**)				Percent of Area (*Kahler*/**DecAID**)			
Black-backed Woodpecker	*60*/**72**	*32*/**25**	*9*/**5**	*ND*/**ND**	*62[1]*/**68[1]**	*16*/**13**	*21*/**18**	*2*/**2**
Pygmy Nuthatch	*48*/**63**	*29*/**22**	*14*/**12**	*10*/**5**	*62[1]*/**68[1]**	*18*/**14**	*13*/**15**	*8*/**4**
White-headed Woodpecker	*39*/**56**	*33*/**25**	*19*/**16**	*10*/**5**	*68*/**72**	*15*/**12**	*9*/**15**	*9*/**5**
Williamson's Sapsucker	*92*/**97**	*9*/**5**	*ND*/**ND**	*ND*/**ND**	*89*/**91**	*11*/**9**	*1*/**1**	*0*/**0**

[1] 30% tolerance level for these species was equal to zero (0).

ND = No Data; The value of the 80% tolerance level exceeds the upper limit of snag density distribution, and is therefore included in the 50%-80% column.

Table W-22. Percent of EMC_ECB Forest Habitat within the Kahler Analysis Area and the DecAID reference condition that meets tolerance levels described in DecAID for cavity excavating species in the ≥10 and ≥20 inch groups.

	Snags >10" dbh				Snags >20" dbh			
	0-30%	30-50%	50-80%	80+%	0-30%	30-50%	50-80%	80+%
Species	Percent of Area (*Kahler*/**DecAID**)				Percent of Area (*Kahler*/**DecAID**)			
Black-backed Woodpecker	*45*/**31**	*36*/**36**	*12*/**23**	*7*/**12**	*52[1]*/**57[1]**	*18*/**8**	*22*/**24**	*8*/**12**
Pygmy Nuthatch	*37*/**24**	*27*/**22**	*16*/**18**	*20*/**38**	*52[1]*/**57[1]**	*20*/**9**	*15*/**16**	*13*/**19**
White-headed Woodpecker	*32*/**20**	*9*/**8**	*15*/**12**	*44*/**62**	*52[1]*/**57[1]**	*19*/**8**	*15*/**16**	*14*/**20**
Williamson's Sapsucker	*82*/**68**	*10*/**21**	*8*/**13**	*ND*/**ND**	*84*/**77**	*12*/**18**	*3*/**4**	*1*/**2**

[1] 30% tolerance level for these species was equal to zero (0).

ND = No Data; The value of the 80% tolerance level exceeds the upper limit of snag density distribution, and is therefore included in the 50%-80% column.

These data indicate that the Kahler Analysis Area is providing snag densities for a variety of cavity excavating species, including a portion that meets or exceeds the 50% and 80% tolerance levels, at similar levels as would have been expected under the reference condition (provided by DecAID).

The Terrestrial Wildlife Inventory (Harris 2007) occurred at 224 Current Vegetation Survey (CVS) plots across the forest between 2003 and 2006. These surveys included avian point counts (aural and visual), small mammal trapping (Sherman and pitfall traps; smoke plates at selected sites), amphibian surveys, and a general site search. These surveys were not designed to collect population data. The Terrestrial Wildlife Inventory provides evidence of presence, relative distribution and abundance of wildlife species, and a baseline for monitoring presence and distribution of management indicator species and sensitive wildlife species at the Forest scale. A number of primary cavity excavators were encountered during these surveys. Observations of the pileated woodpecker, hairy woodpecker, northern flicker, white-breasted nuthatch, pygmy nuthatch, red-breasted nuthatch, Williamson's sapsucker, black-backed woodpecker, red-naped sapsucker, white-headed woodpecker, and Lewis' woodpecker have been recorded in the Kahler analysis area.

STAND MODELING

To assess potential impacts to future standing dead wood (snag) habitat in the affected area, the Forest Vegetation Simulator (FVS, version 3853, Blue Mountains variant) was used to model stand development for a subset of proposed treatment units. Stand exams were conducted in some of the proposed units to provide the basis for modeling. These exams recorded vegetative information (tree species, sizes, etc.) and snag data (size and condition) on small plots within the stands. In other stands, data from the most similar stands in the area was imputed into these stands. Snag transects were also completed in the units in representative areas to provide more comprehensive dead wood data than those collected at sampling plots. The FVS incorporates vegetative data and snag data to grow stands into the future. In the case of Kahler, the stands were grown out 100 years into the future. The model incorporated the following caveats and assumptions:

- The default maximum stand density index (SDIMAX) based on plant association was used for simulating mortality.
- Only senescence and density-related mortality were considered in the model when determining future snag recruitment. Insect and disease mortality, which has historically been a significant source of mortality in the Blue Mountains, was not incorporated into the model. Determining when and where these events may occur, or an "average" background level of these events over the larger landscape would have been highly speculative. As such, the data generated by the model may be lower than what would be expected with background insect and disease mortality occurring.
- Proposed harvest activities would be thinning with a basal area target. The largest trees would generally be retained in proposed commercial thin units. Only trees greater than 7" or 9" (depending on the stand) would be removed in commercial thinning units.
- It is assumed for the purposes of modeling that all commercially thinned stands will be non-commercially thinned after initial overstory treatment is complete. Non-commercial thinning would be done on an as-needed basis in these stands following a post thin assessment. Prescribed underburning was also applied in the year 2020 in the models. Further burning or other vegetative treatment beyond 2020 was not modeled.

Figures W-07 and W-08 show the modeled snag densities (≥10 inches dbh and ≥20 inches dbh) in five proposed treatment units in the Kahler Project. Commercial thinning is proposed in all of the proposed treatment units. These stands were grown into the future with no treatment. Proposed harvest prescriptions (commercial thinning, non-commercial thinning, and underburning) will be

applied to these stands and snag densities will be modeled in the short and long term. These two runs (no treatment and post treatment) will then be compared. Currently, all of the modeled stands meet Forest Plan minimum snag standards in the ≥20 inch group. Over time, snag densities would increase in the modeled stands in both size classes through senescence (old age) and mortality resulting from competition between trees. Under modeled conditions, snag densities in several of the stands would be within or near the highest snag density categories provided by DecAID for both the PPDF and EMC/ECB habitat types.
Snag and downed wood survey transects were carried out in approximately 25 units to determine existing snag and downed wood densities. Snag densities obtained from transect surveys were similar to existing snag densities used in the modeling runs.

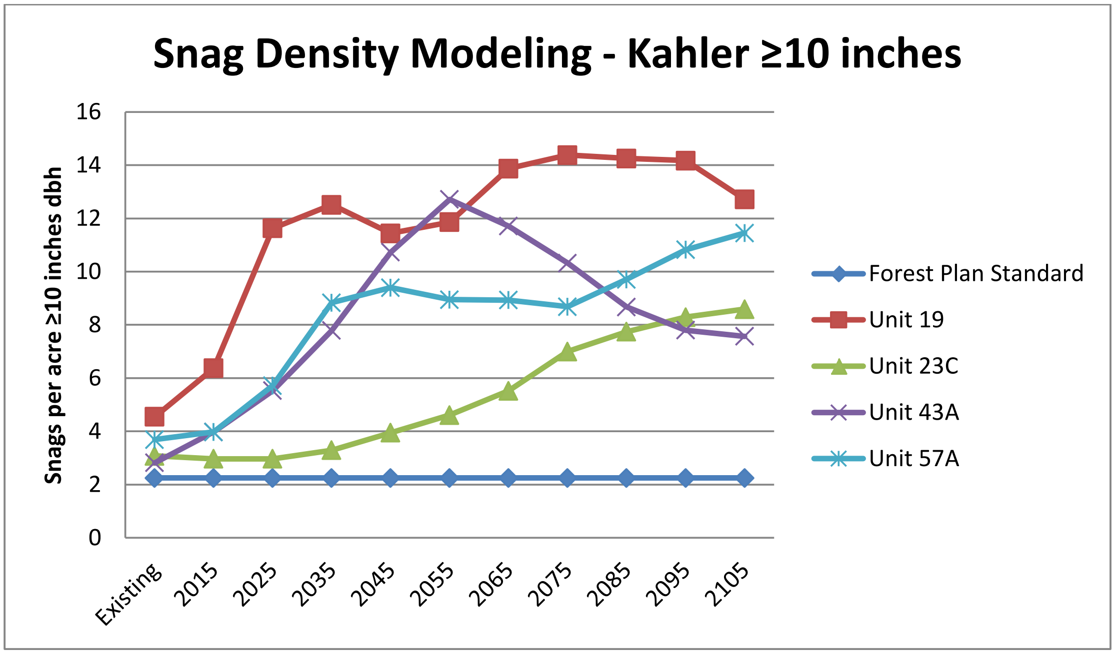

Figure W-07. Modeled snag density in the ≥10 inch dbh category in Kahler units with **no treatment**.

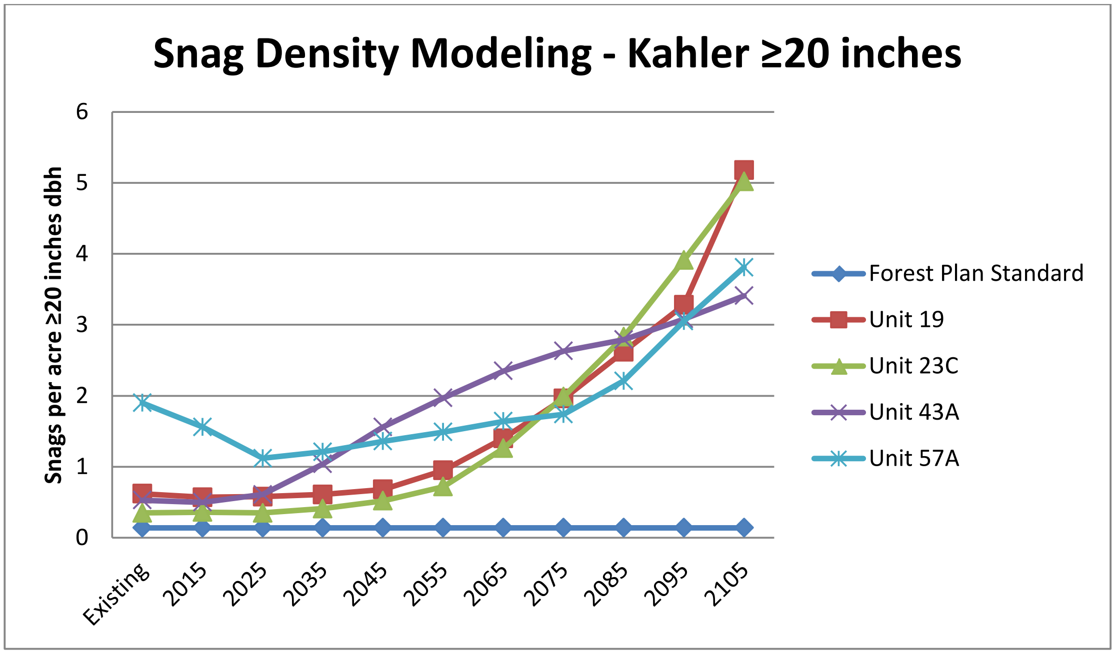

Figure W-08. Modeled snag density in the ≥20 inch category in Kahler units with **no treatment**.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

Within the next five years, dead standing trees (snags) would continue to occupy the project area at current densities and size classes, barring disturbance such as a large scale, high severity wildfire. Although snags would continue to be lost and created on the landscape in the short term, the existing snag density distribution in the Kahler Analysis Area (Figures W-03, W-04, W-05, and W-06) would not be expected to change in this short timeframe.

In the mid and long term (5 to 15+ years), existing snags would decay and fall to the ground, increasing downed wood in the analysis area. In the mid and long term, snag densities have the potential to increase in the analysis area through naturally occurring (background) mortality and mortality caused by insect and disease outbreaks and wildfire. As previously managed stands grow, naturally occurring mortality would reduce the proportion of stands with zero to few snags at the Analysis Area and Forest scale. Mortality caused by insects and disease would be patchy, creating small to moderately sized “islands” with high densities of snags in the early stages of decay. These islands would provide habitat for primary cavity excavators (e.g., black-backed woodpecker, three-toed woodpeckers, and Lewis’ woodpecker) and other wildlife that require pulses of high-density snags. These events would contribute to high fuel loading in some areas (generally isolated moist and cold upland forest stands, and dense dry upland forest stands), and increase the risk of high-severity wildfire. While it is expected that mixed severity fire would occur, there would be larger patches of high severity impacts (due to higher flame lengths and resulting passive crown fire) than would have been expected historically. Snag densities would initially increase due to fire-caused mortality; species that show an affinity for post-fire conditions (e.g., black-backed, three-toed, and hairy woodpeckers) would benefit in the short term following this type of event. Ultimately, snags resulting from this event would fall and snags would be relatively scarce until the regenerating stand becomes old enough to produce large trees, a time period ranging from 80 to 100 years. Continued fire suppression would exacerbate the change in the context of snag habitat from more open stands to closed canopy, multiple-layer stands. Under the no action alternative, species requiring snags in open forests would have less available habitat; those desiring large snags in more dense stands would benefit.

Common to All Action Alternatives

Direct and Indirect Effects

Proposed commercial harvest (with skips and gaps), shrub-steppe enhancement treatments, burning, new system road construction, road use (open, closed, seasonal, and existing temporary roads), and temporary road construction activities would have the same effects on snag habitat; the extent of these activities would vary by alternative, however. Since snags would potentially be lost in proposed treatment units from hazard/danger tree felling, temporary road construction, and landscape burning, and in the future through a reduction in density-dependent mortality, it stands to reason that an increase in acres treated or burned, and miles of road impacted (used, constructed) by these activities would have a greater impact on snags, and potentially the species that depend on these habitat features.

Under the proposed action alternatives, proposed commercial thinning (with skips and gaps) and shrub-steppe enhancement treatment would target green trees for removal to meet silvicultural and wildlife habitat goals for structure and composition. Snags would not be felled in proposed commercial thinning or shrub-steppe enhancement units unless they pose a danger to operators (See Chapter 2, Project Design Criteria); as a result, snags would be maintained to the greatest extent possible (given safety constraints). Potential primary cavity excavator roosting, foraging, and nesting habitat would be lost to provide for safety within treatment units. If snags are felled within treatment units, they would largely be left in place to provide dead downed wood habitat (See Chapter 2, Project Design Criteria). Those less than 12 inches dbh would be permitted for removal only when downed wood densities in a unit meet or exceed levels prescribed in the Project Design Criteria. Monitoring of impacts to snags in timber harvest units on the south end of the Umatilla National Forest has found that danger tree felling impacts a small percentage of the existing snags within commercially treated stands. Monitoring elsewhere on the south end of the Forest indicates that between 4% and 6% of the existing snags within treatment units are felled as hazards (Scarlett 2011). It is expected that a similar level of impact (associated with hazard tree felling) to snags would occur in the Kahler Project Area due to the fact that similar stands (in terms of composition and structure) are being treated. The impact associated with hazard tree felling would not be expected to appreciably change the abundance or density of snags in treatment units, the availability of habitat meeting the 80% tolerance level (for snags ≥10 and ≥20 inches in either the Ponderosa pine/Douglas-fir or Eastside Mixed Conifer/Blue Mountains habitat types), or the distribution of snag density classes at the analysis area or Forest scale. It is expected that stands that are currently meeting or exceeding Forest Plan minimum standards for snag density will continue to do so following treatment.

Commercial thinning (with skips and gaps) would alter the effectiveness of available snag habitat because the context of these stands would change from a closed canopy to a more open setting. In general, managing forests within or towards the historical range of variability should provide habitat for a wide range of cavity excavator species. Commercial thinning would generally occur in dry upland forest stands where open conditions are more representative of the historic condition. These changes would benefit species like the white-headed woodpecker, Lewis' woodpecker, northern flicker, and pygmy nuthatch. Species associated with closed canopy forest that are using dry sites to a greater degree as a consequence of past fire suppression and the resulting ingrowth of shade tolerant tree species (e.g., pileated woodpecker and Williamson's sapsucker) would be less likely to use these stands even though potential nesting, foraging, and roosting structures (snags) would largely be maintained. While habitat for dense-forest associated species would be reduced in the near term, untreated moderate to high density areas, including riparian areas, C1 old growth, some moist and cold upland forest stands, and other areas dropped from consideration for treatment during project development would be available for these species. These dense forest stands would provide habitat for dense-forest associated wildlife species, and would provide for abundant dead wood recruitment in the future. Treatment would promote increased growth rates in residual trees by reducing competition for resources and resulting stress in dense dry forest stands. Studies show a positive growth response in residual stands following restoration thinning treatments in dry upland forest (ponderosa pine) stands (Kolb et al. 2007, Sala et al. 2005, Skov et al. 2005, Feeney et al. 1998). Retention of skips (untreated areas ranging from 0.5 to 2.0 acres and larger, as appropriate) within proposed treatment units would also provide for small patches of dense forest at the stand scale that will provide for higher density-dependent mortality than the surrounding heavily-thinned dry forest matrix.

In the mid and long term, the recruitment of snags would likely be reduced as a consequence of thinning of live trees in dense forested stands (reduced density-dependent mortality). As existing snags within affected stands age and fall, recruitment of new snags may be inadequate to maintain snag densities in treatment units above Forest Plan minimum standards in the long term. Refer to Figures W-09 through W-16 below for examples of modeling outputs for selected stands. For both size classes of snags modeling indicates that burning would increase snag densities, especially the density of smaller snags, in the period immediately following this activity (approximately year 2025). Modeling of snags ≥10 inches dbh indicates that snag densities are projectedto fall after this initial increase in treated stands for a period of years prior to increasing. In several of the modeled stands, average densities were projected to fall below the Forest Plan standard for several decades (approximately 2045 to 2065) before increasing. In others, this trough was projected to be less deep and have a shorter duration; snag densities were projected to meet or exceed the Forest Plan standard for the duration of the modeling period. Modeling of snags ≥20 inches dbh indicates that in the chosen units, snag densities would continue to meet Forest Plan standards over the modeling period. Following the fire-induced increase, snag densities in several of the modelled units were projected to decrease till about year 2055 when they would increase. Other modeled stands projected a similar slight increase related to burning, then closely tracked the snag densities projected for "no treatment" runs through the modeling period. Unpredictable events, such as insect and disease activity and fire-related mortality, which are not accounted for in modeling runs, would likely recruit additional snags above what is projected in the model runs. It is expected that the impacts on future snag recruitment and the snag density distribution at the analysis area scale would be small. It is also expected that average snag densities at the analysis area scale would continue to meet Forest Plan standards following implementation.

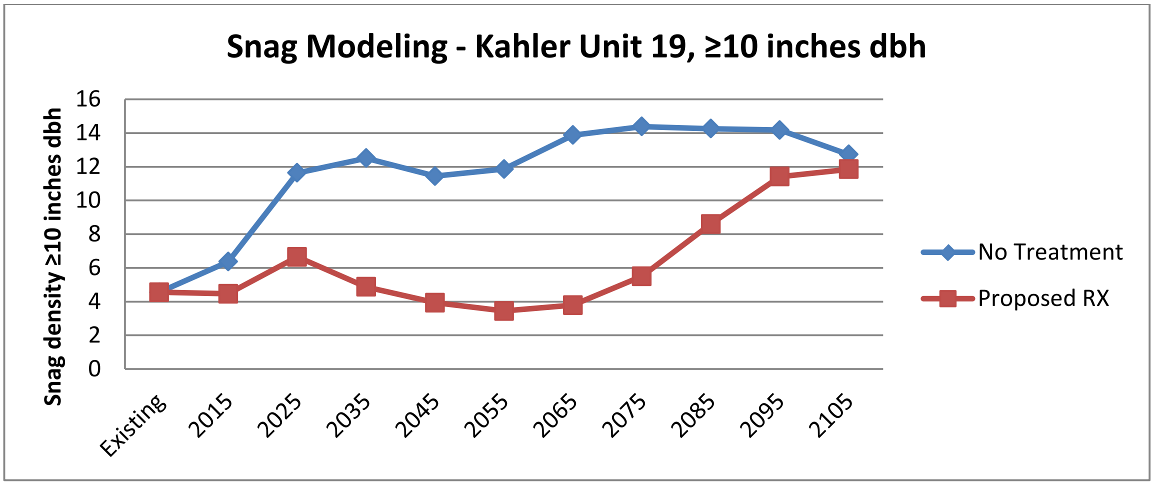

Figure W-09. Stand modeling output for snags ≥10 inches dbh for proposed Unit 19.

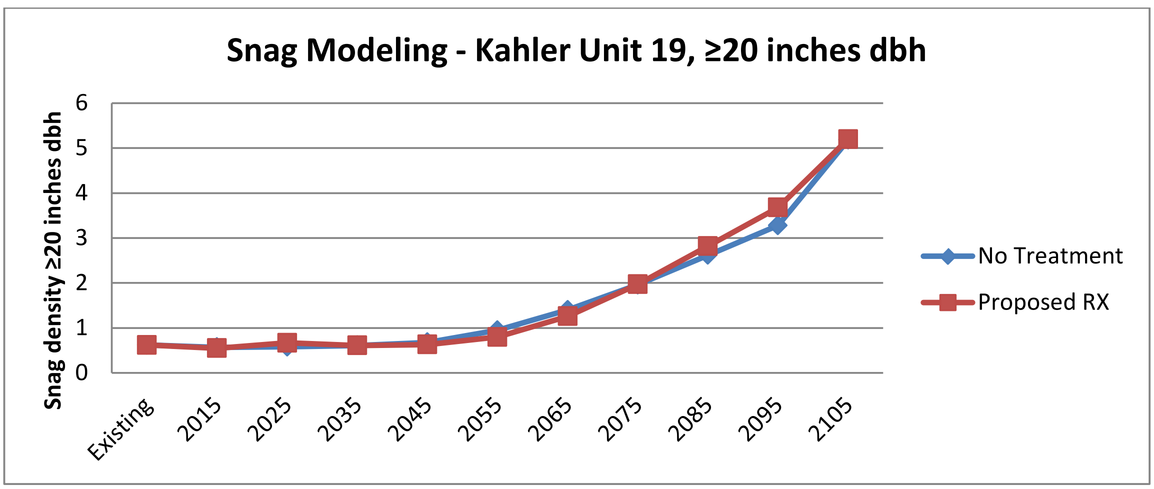

Figure W-10. Stand modeling output for snags ≥20 inches dbh for proposed Unit 19.

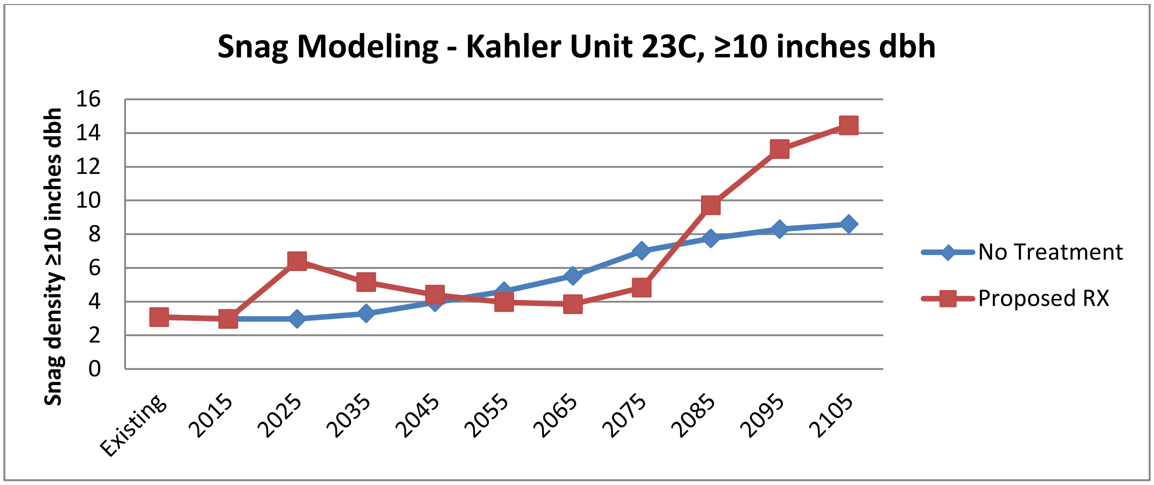

Figure W-11. Stand modeling output for snags ≥10 inches dbh for proposed Unit 23C.

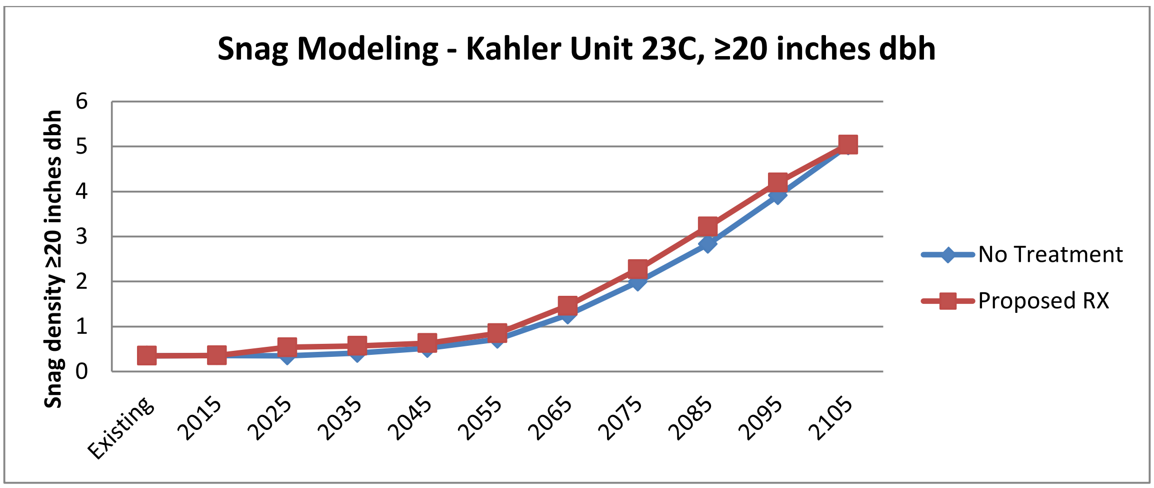

Figure W-12. Stand modeling output for snags ≥20 inches dbh for proposed Unit 23C.

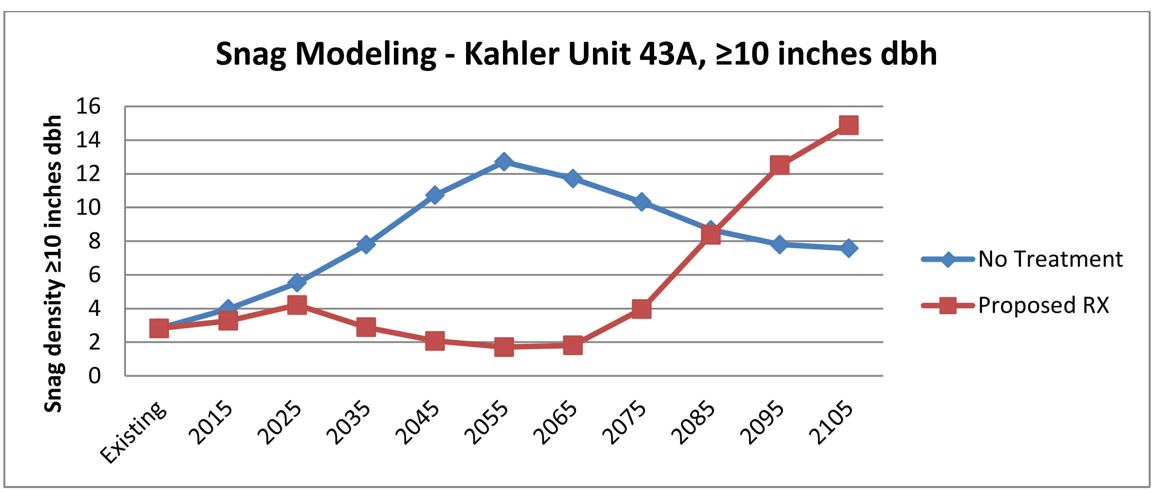

Figure W-13. Stand modeling output for snags ≥10 inches dbh for proposed Unit 43A.

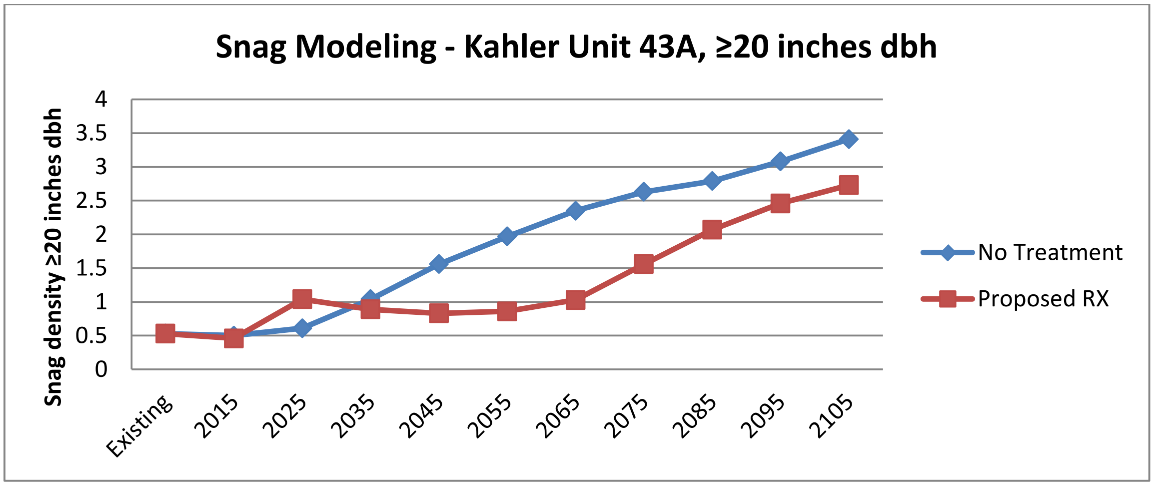

Figure W-14. Stand modeling output for snags ≥20 inches dbh for proposed Unit 43A.

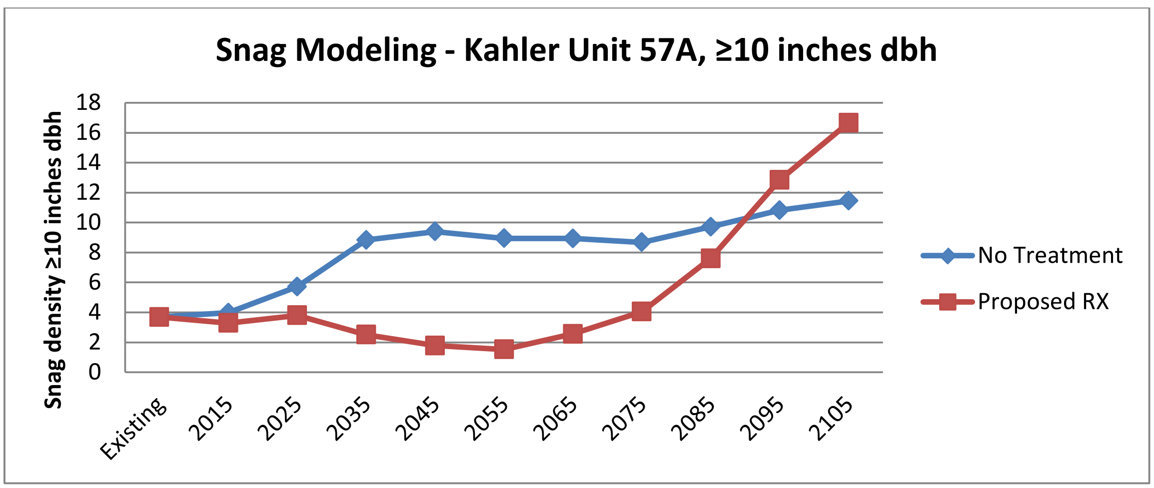

Figure W-15. Stand modeling output for snags ≥10 inches dbh for proposed Unit 57A.

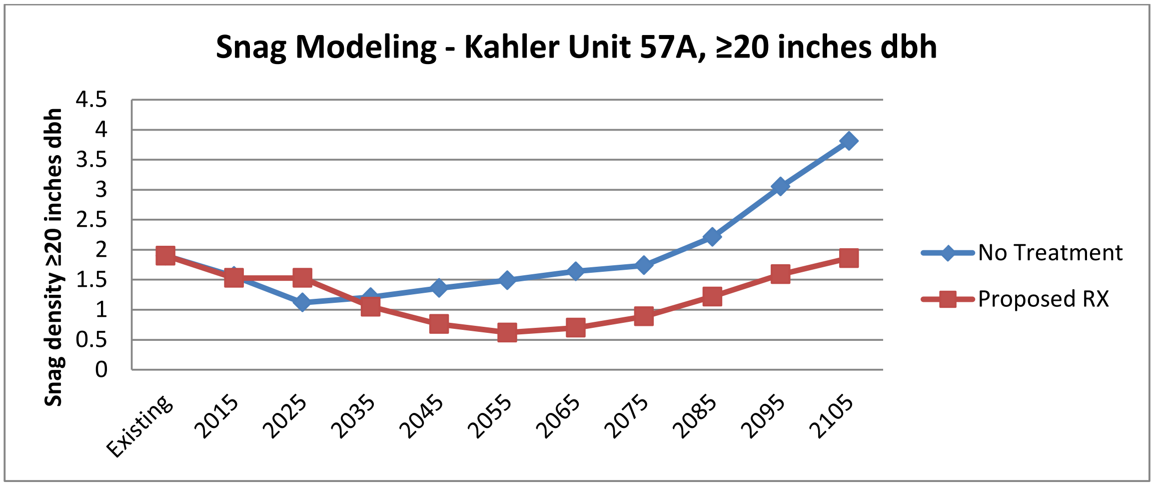

Figure W-16. Stand modeling output for snags ≥20 inches dbh for proposed Unit 57A.

Although not a purpose and need for action in the Kahler project area, commercial thinning may reduce the susceptibility of treated stands to high severity wildfire and insect infestations/disease. It is not expected that the proposed activities would adversely impact species that rely on these events (e.g., black-backed and American three-toed woodpeckers) due to the fact that the proposed activities are not designed to eliminate fire or other disturbances on the landscape; in fact, the treatment activities in dry forest habitat would aid in reestablishing fire (low and mixed severity) as a management tool in these stands. Small, untreated skips within proposed units and untreated stands elsewhere in the analysis area (primarily riparian areas, C1 old growth, and a few moist and cold upland forest stands) would provide dense, overstocked conditions with a potential to be impacted by high severity wildfire and disease/insect events in the future. These habitats (unmanaged habitat, including wilderness and inventoried roadless areas) would also be available at the Forest scale.

Use of the road system also has the potential to affect snags potentially used by primary cavity excavators. Danger tree abatement would occur along open, seasonal, closed, new temporary, existing temporary, and new system roads accessing commercial thin and shrub-steppe units; no danger tree abatement would occur along roads used solely to access non-commercial thin units (See Project Design Criteria, EA Chapter 2). Often those snags that pose a danger along roads are the most valuable to primary cavity excavators due to extensive decay. In the short and mid term, cavity excavators may use the areas adjacent to roads less due to this impact. Due to the linear nature of roads and associated danger tree felling (generally occurring within 150 feet of roads), the impact is not expected to be measureable at the analysis area scale. Large (≥20 inch) danger trees that are felled adjacent to roads would be felled and left to provide for wildlife habitat. Temporary roads would generally follow existing openings where possible, so the impact to snags is expected to be minor.

Burning would occur over the entire 31,000 acre project area; dense moist forest stands and old growth habitat may be excluded to prevent undesired impacts to vegetation in these areas (see Project Design Criteria). Burning of activity fuels and landscape underburning would be likely to affect a portion of the existing snags on affected acres. Herrod and others (2009) and Hessburg and others (2012) found that thinning and burning treatments and burning only treatments in ponderosa pine/Douglas-fir stands affected primarily smaller diameter snags (those less than 8” to 10” dbh) and snags in late stages of decay. Although more resilient to burning, larger snags are lost (felled by fire) at a modest rate to prescribed burning treatments (Hessburg et al. 2010, Harrod et al. 2009). Losses of snags in burned stands are generally offset or exceeded by new snag creation (Hessburg et al. 2010, Harrod et al. 2009). While largely composed of snags smaller than 10" dbh, a portion of medium (10" to 15.9") and large trees (≥16" dbh) were killed by prescribed fire (2% and 1%, respectively) (Harrod et al. 2009). Thies and others (2008) found that as high as 5% of large trees were killed by fire in dry forest stands. Burning in the Kahler area would be expected to have similar impacts on existing snags and snag recruitment (new mortality). Snag modeling indicates that snag creation (≥10 inches dbh) would be greater than snag loss during burning. The mosaic nature of planned low intensity landscape burning and snag modeling results indicate that the impact of landscape burning on snags would be minor. Expected impacts to snag-associated birds (including white-headed and Lewis' woodpecker, pygmy nuthatch, and others in the PPDF and EMC_ECB forest types) would also be minor. Large snags (≥20 inches dbh) would be protected where necessary to ensure that these structure are not lost during burning (see Project Design Criteria). Slash would be pulled away from the base of these snags and they may be scratch lined down to mineral soil if necessary.

Cumulative Effects

Past activities, actions, and events in the Kahler analysis area (Kahler Creek-John Day River, Upper Rock Creek, and Wall Creek watersheds, combined) that have contributed to the existing condition of snag habitat include commercial thinning (approximately 43,466 acres since 1975), regeneration harvest (8,902 acres), and overstory removal (12,858 acres) on National Forest system lands since approximately 1975 (overlap is present on these acres between treatment types), an unknown number of acres of various harvest activities on private and State of Oregon lands, wildfire (including the Wheeler Point, Monument, and Sunflower Fires), fire salvage (approx. 2,864 acres, with most included in commercial thinning acres above), insect and disease outbreaks, danger tree abatement along roads, and firewood cutting. Past harvest and salvage activities throughout the analysis area have directly affected snag density through the removal of dead standing trees ≥10 inches dbh. Some of these harvested acres are currently deficient in snags due to past harvest methods. Past harvest is largely responsible for the existing snag density distribution in the analysis area (see affected environment for the PPDF and EMC/ECB forest types). These activities also reduced potential recruitment of snags by removing green trees; typically, the largest trees in treatment units were harvested. Past wildfire created snags through direct and delayed fire mortality. Excellent high-density snag patches were created within the Wheeler Point, Monument, and Sunflower Fire areas. Fire salvage subsequently impacted high severity-burned forests; the majority of high mortality areas on NFS lands in the Wheeler Point Fire were salvaged (2,614 acres), while only 250 acres in the Monument Fire area was salvaged. Insect outbreaks (spruce budworm) have resulted in high mortality of grand fir and Douglas-fir in some stands within the analysis area, resulting in high quality understory regeneration structure stands with high snag densities. Fuels treatment in the northern portion of the Wildcat II planning area has substantially reduced high snag density habitat in both moist and dry upland forest in the Wall watershed. Danger tree abatement along roads (open and some closed roads) has affected dead standing and green trees that would have become snags in the near future. Past firewood cutting removed snags adjacent to open roads within the analysis area, reducing the density of snags < 24 inches (at stump height) in these areas. Korol and others (2002) noted that management and roads (and associated firewood cutting and hazard tree felling) contributed to large snag declines on Forest Service lands in the Interior Columbia Basin. These activities and events have combined to create the existing condition for snag habitat in the analysis area.

Present and reasonably foreseeable future activities, actions, and events in the analysis area that affect snags include personal use firewood cutting and danger tree abatement along roads, prescribed fire, and hazard tree salvage within the Sunflower Fire area. Firewood cutting would have the same effects as those described above. Danger tree abatement in the Ditch Danger Tree Project continues along open and closed system roads in the Wall Watershed. When combined with firewood cutting, danger tree felling is significantly reducing existing and future snag densities along roads. Prescribed fire is planned for the Wildcat II, Sunflower Bacon, and Rimrock areas. This activity impacts snags to a small degree; some snags, especially smaller snags and those in later stages of decay are lost, while new snags are created. Hazard trees created by the fire would be felled and removed on approximately 196 acres within the Sunflower Fire within 200 feet of selected roads. This activity would reduce existing and future snag densities (through removal of trees that would succumb to delayed fire mortality), and reduce the acreage of high-density snag habitat in the Wall Watershed. The Wall Watershed is currently (after impacts of the fire were used to update the existing condition) deficient in high density snag habitat in the Eastside Mixed Conifer habitat type. Hazard tree salvage would further reduce ephemeral high-density snag habitat that is used by the black-backed woodpecker and other species.

When the expected effects of the action alternatives are combined with the residual and expected effects of past, present, and reasonably foreseeable future actions in the analysis area, they would all add to past reductions in snag habitat. The incremental reduction in existing snags that would occur in commercially thinned stands would be small due to the fact that snags would only be felled where they are a danger to operations within units or along roads. At the stand scale, structural habitat (nesting, foraging, and roosting) for primary cavity excavating birds may be reduced slightly in the short and mid term through hazard/danger tree felling. The loss of snags through prescribed burning would also be relatively minor given measures that would be taken to create a low intensity ground fire. New snags created by burning would partially off-set any loss associated with this activity. In the mid and long term, reductions in snag recruitment (through reduced density-dependent mortality) would occur over a large area due to the extent of treatment in the Kahler Project area. It is likely that population levels of some primary cavity excavators (those adapted to higher snag densities in denser stands) would be reduced at this time scale. It is expected that average snag densities at the scale of the Kahler Creek-John Day River, Upper Rock Creek, and Wall Creek watersheds may decrease to a small degree, but would continue to meet Forest Plan standards after treatment. The snag density distribution at the analysis area scale (for both the Ponderosa Pine/Douglas-fir and Eastside Mixed Conifer/Blue Mountains Forest types) may change slightly. It is expected that there will be slight increases in the proportion of these habitat types in the lower density groups, and slight reductions in the mid-density groups. The analysis area would maintain a snag density distribution that resembles the DecAID reference condition; by doing so, habitat for the primary cavity excavator group will be maintained and will contribute towards the viability of this group at the Forest scale (Landres et al. 1999).

Commercially thinned (with skips and gaps) dry upland forest stands (PPDF DecAID type), would have a more appropriate structure, composition, and density after implementation, when compared to historic conditions. When this is combined with the reintroduction of frequent low severity and mixed severity fire, it is expected that snag size and density would also be moved toward historic conditions described in DecAID and other science. Treatment activities would also reduce the susceptibility of treated stands to high severity wildfire. The availability of post-fire snag habitat is not expected to be cumulatively reduced due to the fact that high severity fire would not be eliminated on the landscape. Areas outside of treatment units (including riparian areas, Dedicated Old Growth, and other areas) would remain susceptible to high severity wildfire due to vegetative structure and composition and disturbance factors such as insects and disease. Potential habitat for black-backed woodpecker, three-toed woodpecker, and other species that utilize burned forests would therefore be maintained at the analysis area and Forest scale.

Alternative 2

Direct and Indirect Effects

The effects under this alternative would be similar to those described under *Common to All Action Alternatives*. This alternative would have the greatest impact on snags and those species that depend on this habitat feature due to the fact that it would impact the most acres when compared to the other alternatives. Approximately 11,540 acres would be commercially thinned (with skips and gaps) and treated to enhance shrub-steppe habitat (includes commercial and non-commercial sized material). Impacts to existing snags on these treatment acres units would be entirely due to hazard tree felling and losses to burning that may occur. The snag density distribution at the analysis area scale (for both the Ponderosa Pine/Douglas-fir and Eastside Mixed Conifer/Blue Mountains Forest types) may change slightly. It is expected that there will be slight increases in the proportion of these habitat types in the lower density groups, and slight reductions in the mid-density groups. The analysis area would maintain a snag density distribution that resembles the DecAID reference condition. This alternative would have the greatest long-term impact on future snag densities due to the fact that it would impact stand density on the most acres when compared to Alternatives 3 and 4.

Danger tree felling along existing open, seasonal, and closed system roads and temporary roads would also contribute to additional losses of snags. Under this alternative, danger tree abatement would occur along 80.4 miles of open road, 5.7 miles of seasonal road, 58.2 miles of closed road, and 10.0 miles of temporary road (3.0 miles new temp, 6.9 miles existing temp roads). As this alternative would utilize the most miles of open, seasonal, closed, and temporary roads (existing and new), the expected impact associated with danger tree felling would be the greatest when compared to the other action alternatives. Under this alternative, approximately 9.0 miles of existing open road would be closed to motorized vehicles year round and an additional 7.5 miles closed seasonally (during winter). Dead wood along these roads would no longer be available for firewood gathering, slightly reducing future impacts to dead wood in the analysis area.

Cumulative Effects

The cumulative effects under this alternative would be similar to those described under *Common to All Action Alternatives*. This alternative would contribute the most to past reductions in snag habitat due to the fact that it would treat the most acres when compared to the other action alternatives. Under this alternative, a large proportion of the forested acreage in the Project Area would be treated. Short and mid term impacts to snag habitat would therefore occur over a large, contiguous area (with small skips). This impact, over such a large area, in a relatively short amount of time may cumulatively impact population levels of some cavity excavating species, especially those that utilize dense upland forest habitat with high snag densities. While skips would provide for untreated habitat within the larger matrix of heavily thinned stands, these patches would be small, and may not be adequate to compensate for losses in snag habitat (through reduced recruitment) that would occur following treatment. The snag density distribution at the analysis area scale (for both the Ponderosa Pine/Douglas-fir and Eastside Mixed Conifer/Blue Mountains Forest types) may change slightly. It is expected that there will be slight increases in the proportion of these habitat types in the lower density groups, and slight reductions in the mid-density groups. The analysis area would maintain a snag density distribution that resembles the DecAID reference condition. It is not expected that the activities proposed under this alternative would negatively impact the primary cavity excavator group and their habitat in the long term.

Forest Plan Consistency

Because the Kahler project (commercial thinning, shrub-steppe enhancement, and burning) would impact approximately 2% (approximately 1% mechanical treatment and 2% low intensity underburning) of the land on the Umatilla National Forest, the overall direct, indirect, and cumulative effects under this project would result in a small negative habitat trend for the primary cavity excavator group. The loss of snags resulting from hazard tree felling in proposed commercial thin and shrub-steppe enhancement units, danger tree felling along roads, reduced recruitment through a reduction in density-dependent mortality, and burning would be minor at the analysis area scale and insignificant at the scale of the Forest. Snag densities in treatment units are expected to meet Forest Plan minimum standards in the short and mid term. In the long term, snag densities in some treatment units may fall below Forest Plan standards. It is expected that the distribution of snag density classes in the analysis area would be maintained at levels similar to the reference condition provided by DecAID. By providing a distribution of snag density classes that closely resembles the reference condition, it is expected that the analysis area will contribute toward the viability of primary cavity excavators at the Forest scale. The activities proposed under the Kahler Project (Alternative 2) would also move the project area toward the Historic Range of Variability (HRV) for structure, composition, and density. By managing habitat for the HRV, it is expected that adequate habitat will be provided for cavity excavating species because these species survived those levels of habitat in the past (Haufler et al. 1996, Agee 2002, Landres et al. 1999). Under this alternative, the Kahler Project would be consistent with the Forest Plan and subsequent direction relating to habitat management, and thus the continued viability of the primary cavity excavator group is expected on the Umatilla National Forest.

Alternative 3

Direct and Indirect Effects

The effects under this alternative would be similar to those described under *Common to All Action Alternatives*. This alternative would have less impact on snags and associated wildlife than Alternative 2 due to reduced treatment acres. Approximately 10,710 acres would be commercially thinned (with skips and gaps) and treated to enhance shrub-steppe habitat (includes commercial and non-commercial sized material). Impacts to existing snags on these treatment acres units would be entirely due to hazard/danger tree felling and losses to burning that may occur. Under this alternative, larger blocks of dense dry forest habitat would be dropped to address a number of issues identified during scoping. This alternative would provide larger skips distributed across the landscape for dense dry forest-associated wildlife; these larger blocks would provide areas where density-dependent snag mortality (primarily insects and disease) is expected to remain relatively high. The snag density distribution at the analysis area scale (for both the Ponderosa Pine/Douglas-fir and Eastside Mixed Conifer/Blue Mountains Forest types) may change slightly. It is expected that there will be slight increases in the proportion of these habitat types in the lower density groups, and slight reductions in the mid-density groups. The analysis area would maintain a snag density distribution that resembles the DecAID reference condition.

The expected impact associated with burning would be virtually the same as described under the *Common to All Action Alternatives* section above. Prescribed burning impacts on acres dropped from treatment activities under this alternative would have varying effects. As there was no vegetative treatment in these units, there is no harvest-created slash mat that may pose a risk to snags during burning.

Under this alternative, danger tree abatement would occur along 76.9 miles of open road, 5.7

miles of seasonal road, 53.5 miles of closed road, and 8.4 miles of temporary road (3.0 miles new temp, 5.4 miles existing temp roads) within the analysis area. As this alternative would utilize fewer miles of open, seasonal, closed, and temporary (new and existing) roads, the expected impact associated with danger tree felling would be less than that under Alternative 2. Under this alternative, approximately 9.9 miles of existing open road would be closed to motorized vehicles year round and an additional 5.7 miles closed seasonally (during winter). Dead wood along these roads would no longer be available for firewood gathering, slightly reducing future impacts to dead wood in the analysis area.

Cumulative Effects

The expected impact on snags under this alternative would be less than that of Alternative 2 due to a reduction in treatment acres and miles of road used to access units and retention of larger patches of high and moderate density dry upland forest across the landscape. As a result, the incremental effect on snags would be slightly less than under Alternative 2. The cumulative reduction in snags would in turn be less as well; it is not expected that the activities proposed under this alternative would negatively impact the primary cavity excavator group and their habitat in the long term.

Forest Plan Consistency

Because the Kahler project (commercial thinning, shrub-steppe enhancement, and burning) would impact approximately 2% (approximately 1% mechanical treatment and 2% low intensity underburning) of the land on the Umatilla National Forest, the overall direct, indirect, and cumulative effects under this project would result in a negative habitat trend for the primary cavity excavator group. The loss of snags resulting from hazard tree felling in proposed commercial thin and shrub-steppe enhancement units, danger tree felling along roads, reduced recruitment through a reduction in density-dependent mortality, and burning would be minor at the analysis area scale and insignificant at the scale of the Forest. Snag densities in treatment units are expected to meet Forest Plan minimum standards in the short and mid term. In the long term, snag densities may fall below Forest Plan standards in some treatment units due to a reduction in density-dependent mortality in overstocked dry forest stands. It is expected that the distribution of snag density classes in the analysis area would be maintained at levels similar to the reference condition provided by DecAID. By providing a distribution of snag density classes that closely resembles the reference condition, it is expected that the analysis area will contribute toward the viability of the primary cavity excavator group at the Forest scale. The activities proposed under the Kahler Project (Alternative 3) would also move the project area toward the Historic Range of Variability (HRV). By managing habitat for the HRV, it is expected that adequate habitat will be provided for cavity excavating species because these species survived those levels of habitat in the past (Haufler et al. 1996, Agee 2002, Landres et al. 1999). Under this alternative, the Kahler Dry Forest Restoration Project would be consistent with the Forest Plan and subsequent direction relating to habitat management; therefore, the continued viability of the primary cavity excavator group is expected on the Umatilla National Forest.

Alternative 4

Direct and Indirect Effects

The effects under this alternative would be similar to those described under *Common to All Action Alternatives*. This alternative would have less impact on snags and associated wildlife than Alternatives 2 and 3 due to reduced treatment acres. Approximately 9,695 acres would be commercially thinned (with skips and gaps) and treated to enhance shrub-steppe habitat (includes commercial and non-commercial sized material). Impacts to existing snags on these treatment acres units would be entirely due to hazard/danger tree felling and losses to burning that may occur. In addition to retaining larger blocks of dense dry forest habitat to address issues identified during scoping, this alternative would also drop all non-fire treatment in Class IV RHCAs and several units that would require new temporary road construction. These larger blocks and unharvested RHCAs would provide areas where density-dependent snag mortality (primarily insects and disease) is expected to remain relatively high. The snag density distribution at the analysis area scale (for both the Ponderosa Pine/Douglas-fir and Eastside Mixed Conifer/Blue Mountains Forest types) may change slightly. It is expected that there will be slight increases in the proportion of these habitat types in the lower density groups, and slight reductions in the mid-density groups. The analysis area would maintain a snag density distribution that resembles the DecAID reference condition.

The expected impact associated with burning would be virtually the same as described under the *Common to All Action Alternatives* section above. Prescribed burning impacts on acres dropped from treatment activities under this alternative would have varying effects. As there was no vegetative treatment in these units, there is no harvest-created slash mat that may pose a risk to snags during burning.

Under this alternative, danger tree abatement would occur along 76.9 miles of open road, 5.7 miles of seasonal road, 51.5 miles of closed road, and 5.4 miles of temporary road (existing temp roads) within the analysis area. No new temporary road would be constructed under this alternative. As this alternative would utilize the fewest miles of open, seasonal, closed, and temporary (new and existing) roads, the expected impact associated with danger tree felling would be the least when compared to the other action alternatives. Under this alternative, approximately 10.0 miles of existing open road would be closed to motorized vehicles year round and an additional 5.7 miles closed seasonally (during winter). Dead wood along these roads would no longer be available for firewood gathering, slightly reducing future impacts to dead wood in the analysis area.

Cumulative Effects

The expected impact on snags under this alternative would be less than the other action alternatives due to a reduction in treatment acres and miles of road used to access units, retention of larger patches of high and moderate density dry upland forest across the landscape, and dropping all RHCAs from mechanical treatment. As a result, the incremental effect on snags would be the least under this alternative. The cumulative reduction in snags would in turn be less as well; it is not expected that the activities proposed under this alternative would negatively impact the primary cavity excavator group and their habitat in the long term.

Forest Plan Consistency

Because the Kahler project (commercial thinning, shrub-steppe enhancement, and burning) would impact approximately 2% (approximately 1% mechanical treatment and 2% low intensity underburning) of the land on the Umatilla National Forest, the overall direct, indirect, and cumulative effects under this project would result in a negative habitat trend for the primary cavity excavator group. The loss of snags resulting from hazard tree felling in proposed commercial thin and shrub-steppe enhancement units, danger tree felling along roads, reduced recruitment through a reduction in density-dependent mortality, and burning would be minor at the analysis area scale and insignificant at the scale of the Forest. Snag densities in treatment units are expected to meet Forest Plan minimum standards in the short and mid term. In the long term, snag densities may fall below Forest Plan standards in some treatment units due to a reduction in density-dependent mortality in overstocked dry forest stands. It is expected that the distribution of snag density classes in the analysis area would be maintained at levels similar to the reference condition provided by DecAID. By providing a distribution of snag density classes that closely resembles the reference condition, it is expected that the analysis area will contribute toward the viability of the primary cavity excavator group at the Forest scale. The activities proposed under the Kahler Project (Alternative 4) would also move the project area toward the Historic Range of Variability (HRV). By managing habitat for the HRV, it is expected that adequate habitat will be provided for cavity excavating species because these species survived those levels of habitat in the past (Haufler et al. 1996, Agee 2002, Landres et al. 1999). Under this alternative, the Kahler Dry Forest Restoration Project would be consistent with the Forest Plan and subsequent direction relating to habitat management; therefore, the continued viability of the primary cavity excavator group is expected on the Umatilla National Forest.

PILEATED WOODPECKER

AFFECTED ENVIRONMENT

The pileated woodpecker was selected as a MIS to be an indicator of dead and downed tree habitat in mature and old growth mixed conifer stands. It is assumed that if good habitat is provided for pileated woodpeckers and their population is maintained at some desired level, that adequate habitat is also being provided for other species that share similar habitat requirements (USDA 1990, page 2-9). The pileated woodpecker plays an important ecological role by excavating nest cavities that are later used by other birds and small mammals (Thomas 1979) and by feeding on forest insect pests. In the Blue Mountains of northeastern Oregon, 22 species of birds and 24 species of mammals utilize vacated woodpecker cavities for reproduction, roosting, shelter, and hibernation (Bull and Meslow 1977). Examples of other wildlife species in the Blue Mountains that utilize nest cavities or roost sites include; bushytail woodrats, flying squirrels, red squirrels, Vaux's swifts, and American marten. Species associated with the same or similar cover types and seral-structural stages include the Williamson's sapsucker, Hammond's flycatcher, chestnut-backed chickadee, brown creeper, winter wren, golden-crowned kinglet, varied thrush, silver-haired bat, and hoary bat (Wisdom et al. 2000).

The Land and Resource Management Plan (USDA 1990) established Designated and Managed Old Growth stands (Management Areas C1 and C2) to provide habitat for the pileated woodpecker and other old growth associated species. All existing old growth forest habitat on the Umatilla was identified/inventoried and mapped on aerial photos by Ranger District personnel. Specific units were then designated and mapped to meet the minimum size and distributional requirements for MIS (Forest Process Document No. 118, 1990). For pileated woodpecker, the Forest Plan calls for individual habitat units of 300 contiguous acres in size (may be 50-acre minimum sized units no greater than one-quarter mile apart to total 300 acres) in later seral stages (V or VI) as reproduction areas distributed throughout the Forest so that generally each 12,000 to 13,000 acre area of capable habitat contains at least one suitable habitat area. Capable habitat units may be utilized where no suitable habitat is available. An additional 300 acres of feeding habitat in close proximity to habitat units will be provided. In all, 80,275 acres of old growth habitat on the Umatilla National Forest were set aside as management areas C1 and C2, with pileated woodpecker suitable and capable old growth habitat accounting for 58,914 acres of this total. These acres were allocated with the intention to maintain habitat diversity, preserve aesthetic values, and provide old-growth habitat for wildlife. The rationale for developing the Old Growth (C1 and C2) Units (grid) on the Forest states that "*The assumptions, calculations, and /or guidelines meet Regional Office and Forest planning direction. These procedures also provide the rationale for designating the old growth/mature tree habitat units on the Forest….and summarizes the habitat needed to maintain viable populations of management indicator species"* (Forest Process Document No. 118 1990). These management areas were designed to serve as the foundation for ensuring MIS population viability at the Forest scale.

The pileated woodpecker is a resident species from southern and eastern British Columbia and southwestern Mackenzie across southern Canada to Quebec and Nova Scotia, south in Pacific states to central California, in the Rocky Mountains to Idaho and western Montana, in the central and eastern U.S. to the eastern Dakotas, Gulf Coast, and southern Florida, and west in the eastern U.S. to Iowa, Kansas, Oklahoma, and Texas (NatureServe 2014). This species is a wide-spread resident in forested areas of Oregon and Washington including the Olympic Peninsula, Coastal Mountains, Klamath Mountains, Cascade Mountains, Blue Mountains, Northeast Washington, and forested fringes of the Puget Trough, Willamette, Rogue and Umpqua Valleys (NatureServe 2014). This species is well distributed across the Umatilla National Forest.

The pileated woodpecker occurs primarily in dense mixed-conifer forest in late seral stages or in deciduous tree stands in valley bottoms. The association with late seral stages stems from the need for large diameter snags or living trees with decay for nest and roost sites, large diameter trees and logs for foraging on ants and other arthropods, and a dense canopy to provide cover from predators (Marshall et al. 2003). This species is generally absent from higher and lower elevations due to lack of large trees for nesting, roosting, and foraging (Marshall et al. 2003). Stands of pure ponderosa pine typically lack the abundance of snags and downed wood necessary for foraging habitat for pileated woodpeckers. Home range size has also been found to increase with increasing amounts of ponderosa pine forest, suggesting that this type is poor habitat (Bull and Holthausen 1993). Densities of nesting pairs of pileated woodpeckers were positively associated with the amount of late structural stage forest and negatively associated with the amount of area dominated by ponderosa pine and the amount of area with regeneration harvests since 1970 (Bull et al. 2007). Pileated woodpecker abundance increased with increasing amounts of forest that was unlogged, $\geq$ 60% canopy closure, and old growth (Bull and Holthausen 1993). Closed canopy forests were not essential for use by pileated woodpeckers, although nest success was higher in home ranges that had greater amounts of forested habitat with $\geq$60% canopy closure (Bull et al. 2007). Nesting success has been found to be less where a greater proportion of the home range area has been harvested (primarily fuels treatment) (Bull et al. 2007). The mean home range size for pileated woodpecker pairs in northeast Oregon is 1,005 acres; home range size had a range of 793 to 1,556 acres (Bull and Holthausen 1993). Bull et al. (2007) found that high tree mortality and loss of canopy closure in stands of grand fir and Douglas-fir did not appear to be detrimental to pileated woodpeckers provided that large dead or live trees and logs were abundant and that stands were not subject to extensive harvest.

Threats to the pileated woodpecker are avian predators, including northern goshawks (*Accipiter gentilis*), sharp-shinned hawk (*Accipiter striatus*) and Cooper's hawks (*A. cooperi*), red-tailed hawks (*Buteo jamaicensis*) and great-horned owls (*Bubo virginianus*). Bull and others (2007) report that timber harvest has had a negative effect on habitat of this species. Removal of large diameter live and dead trees, of down woody material, and of canopy reduces nest and roost sites, foraging habitat, and protective cover. Prescribed fire and mechanical fuel reduction treatments were found to reduce the amount of foraging habitat (snags, stumps, and down logs) and abundance of ants (prey) of the pileated woodpecker in the short term (1 to 3 years) (Bull et al. 2005a). Firewood collection and snag felling along roadsides also reduces the availability of snags for nesting and roosting. Bate et al. (2007) found that snag numbers were lower adjacent to roads due to removal for safety considerations, removal as firewood, and other management activities. Other literature has also indicated the potential for reduced snag abundance along roads (Wisdom et al. 2000).

Other reports indicate that major threats are (from greatest to least): (1) conversion of forest habitats to non-forest habitats, (2) short rotation, even-age forestry, (3) monoculture forestry, (4) forest fragmentation, (5) removal of logging residue, downed wood, and pine straw that would ultimately put nutrients back into the ecosystem and provide foraging substrate, (6) lightning striking cavity/roost trees because they are often the oldest, tallest trees within a stand, (7) deliberate killing by humans, and (8) toxic chemicals (Jackson et al. 1998).

The conservation status of a species is an indicator of the likelihood of that species continuing to survive either in the present day or the future. Many factors are taken into account when assessing the conservation status of a species: not simply the number remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and others. The conservation status of the pileated woodpecker was identified at the global, national, and state of Oregon geographical areas by NatureServe; by listing status from Federal and State Threatened and Endangered Species lists and Sensitive Species lists; by the U.S. Fish and Wildlife Service *Birds of Conservation Concern;* by the Oregon Conservation Strategy; and by the Partners in Flight bird conservation Strategy - *Conservation Strategy for Landbirds in the Northern Rocky Mountains of Oregon and Washington*. Table W-23 shows the current conservation status of the pileated woodpecker.

Table W-23. Conservation Status of the Pileated Woodpecker.

NatureServe Status			Federal Status		State Status		Other	
Global Status	National Status	State Status	Federally Listed, Proposed, Candidate, Delisted Species, Species of Concern?	Regional Forester's Sensitive Species?	Threatened, Endangered, Candidate Wildlife Species in Oregon?	ODFW Sensitive Species List (2008)?	Oregon Conservation Strategy?	Conservation Strategy for Landbirds in the Northern Rocky Mountains of Oregon and Washington
*G5--Secure	*N5--Secure	*S4--Apparently Secure	Not listed.	Not listed.	Not listed.	**Vulnerable in Blue Mountains	Strategy Species in the Blue Mountains Eco-region.	Not a focal species

* NatureServe conservation status ranks are based on a one to five scale, ranging from critically imperiled (1) to demonstrably secure (5). Status is assessed and documented at three distinct geographic scales-global (G), national (N), and state/province (S).
**The Oregon Department of Fish and Wildlife Sensitive Species List status of Vulnerable signifies that the species are facing one or more threats to their populations and/or habitats. Vulnerable species are not currently imperiled with extirpation from a specific geographic area or the state but could become so with continued or increased threats to populations and/or habitats.

The population trend of the pileated woodpecker was assessed at the continental, eco-regional, bird conservation region, and Blue Mountains scales to provide the context from which project-level effects and forest-scale viability determinations can be made. The Blue Mountains are within the Northern Rockies Bird Conservation Region (BCR). The population trend was determined by using data and analyses from the North American Breeding Bird Survey (BBS) Project (Sauer et al. 2011) and the Partners in Flight Landbird population estimates and species assessments database. The BBS indicate that there was an estimated 2 percent population increase per year in Oregon and a 4.6 percent population increase per year in the Northern Rockies BCR during the period from 1966 to 2010 (Sauer et al. 2011). Breeding bird survey data indicate that while there is a positive population trend, the reliability rating for the observed trend is yellow. Refer to http://www.mbr-pwrc.usgs.gov/bbs/cred.html for an explanation of this reliability rating. The Partners in Flight database (http://www.rmbo.org/pif/scores/scores.html) indicates that for the Northern Rockies Bird Conservation Region (BCR 10), population trends show large positive increases. Expected future conditions for breeding populations are expected to remain stable and no threats to the population are known; as a result, the pileated is not listed as a species of regional concern.

Special habitat features include large diameter snags, down logs, and large hollow trees (Wisdom et al. 2000). Pileated show a strong selection of snags larger than 21 inches dbh for nesting (Bull 1987, Raley and Aubry 2004). Bull and Holthausen (1993) found that large snag (>20 inches dbh) density was the best predictor of density of pileated woodpeckers. Typical nests are in snags with broken tops, and little remaining bark; Ponderosa pine (typically in mixed conifer stands) and western larch have been found to be preferred species in the Blue Mountains (Bull 1987). Large snags and down logs are important foraging substrate for pileated woodpeckers (Bull and Holthausen 1993). Carpenter ants (*Camponotus* spp.) are the primary food of pileated woodpeckers (Bull and Jackson 1995). Carpenter ants comprised 95% of the diet of pileated woodpeckers on the Starkey Experimental Forest (Beckwith and Bull 1985). Pileated woodpeckers roost inside tree cavities at night. Roost trees are presumed to be used to reduce predation and to conserve energy by minimizing heat loss in the winter. In northeastern Oregon (Union, Baker, and Umatilla Counties) the majority of roost trees were in grand fir (62%), both live and dead, that were extensively decayed by Indian paint fungus (*Echinodontium tinctorium*) and had a hollow interior (Bull et al. 1992).

The DecAID Advisor provides information on dead wood use by a large group of wildlife species, including the pileated woodpecker. Table W-24 below displays the snag density tolerance levels for the pileated woodpecker in the Eastside Mixed Conifer/Blue Mountains habitat type in the ≥10 inch and ≥20 inch diameter groups. Snag densities derived from current vegetation survey data for the moist upland forest potential vegetation group (approximating the Eastside Mixed Conifer/Blue Mountains habitat type) in the Kahler Creek-John Day River, Upper Rock Creek, and Wall Creek watersheds were compared to the pileated woodpecker cumulative species curves provided in DecAID. Estimates of the existing average snag density were below the 80% tolerance level for the pileated woodpecker in the >10-inch and the >20-inch diameter groups, when compared with the cumulative species curves in DecAID (Table W-22). It should be noted that tolerance levels calculated for the pileated woodpecker and other mixed-conifer-associated species were derived from plots centered on nest sites, which typically occur in locations with more dead wood than the average available. As a result, these data may provide a better approximation of dead wood components in higher density clumps than the stand or landscape average of snag amounts (densities). As well, use of the average snag density over the entire analysis area provides no indication of the existing snag density distribution across the analysis are, including areas with no snags and areas with snags far in excess of DecAID tolerance levels. In addition, see the note below in Table W-24 related to the calculation of average snag densities.

Table W-24. Snag density tolerance level data (DecAID) and existing snag density data (Kahler Analysis Area) for the pileated woodpecker in the Eastside Mixed Conifer/Blue Mountains habitat type.

Diameter Group (Inches DBH)	Snag Density (#/acre) DecAID Tolerance Levels[1]			Average Snag Density[1] Kahler Analysis Area
	30%	50%	80%	
> 10	14.9	30.1	49.3	47.3[2]
> 20	3.5	7.8	18.4	8.0[2]

1 For the large trees structural condition class and snag density data from current vegetation survey inventories in the Kahler Analysis Area.

2 Inclusion of the Wall Watershed in the CVS plot analysis skewed average snag densities significantly from those observed in the Kahler Creek-John Day River and Upper Rock Creek watersheds. Excluding the Wall Creek Watershed would result in snag densities of 11.1 and 2.9 snags per acre in the >10 and >20 inch groups, respectively.

The distribution of snags in unharvested plots for the Eastside Mixed Conifer forest type in DecAID (Mellen-McLean et al. 2012) is used as a surrogate to represent the potential “historic” distribution of snags. This reference condition will be compared with the current distribution of snags for the Eastside Mixed Conifer Forest type in the Kahler Creek-John Day River, Upper Rock Creek, and Wall Creek watersheds. It is noted in DecAID that caution must be used when using unharvested plot data as a surrogate for describing the historic condition in forested habitats on the east side of Oregon. These unharvested plots may have been impacted by past management activities. In some areas, dead wood levels may be elevated due to increased mortality resulting from fire suppression, while in others, snag densities may be depleted below historic conditions due to intense fire or fuelwood cutting.

Published estimates of historic dead wood conditions in mixed conifer stands of eastern Oregon are relatively similar to those provided by the DecAID Advisor. Agee (2002) estimated a snag density of approximately 10 snags per acre greater than 9 inches dbh in mixed and moderate severity fire regimes. As part of the Interior Columbia Basin Ecosystem Management Project, Korol and others (2002) estimated a historic range of variability for snag densities in mixed conifer, high severity fire regimes of 3.8 to 7.0 snags per acre greater than 20 inches dbh (average 5.4 per acre). These published estimates are lower than densities displayed in the wildlife data for this habitat type (Mellen-McLean at al. 2012), but between the 30% and 80% estimates for inventory data (Mellen-McLean et al. 2012). Because estimates derived from literature and DecAID inventory data are similar, inventory data is expected to provide a reasonable estimate of historic conditions in this habitat type.

Figures W-17 and W-18 compare the current distribution of snags in the Kahler Analysis Area and the Umatilla National Forest with the unharvested (reference) distribution of snags for the Eastside Mixed Conifer/Blue Mountains Habitat type (large structure only) in DecAID. Snag analysis at the Forest and Kahler analysis area (Kahler Creek-John Day River, Upper Rock Creek, and Wall Creek Watersheds) scale was completed using Gradient Nearest Neighbor data, which is derived from multiple sources, including CVS and FIA plots.

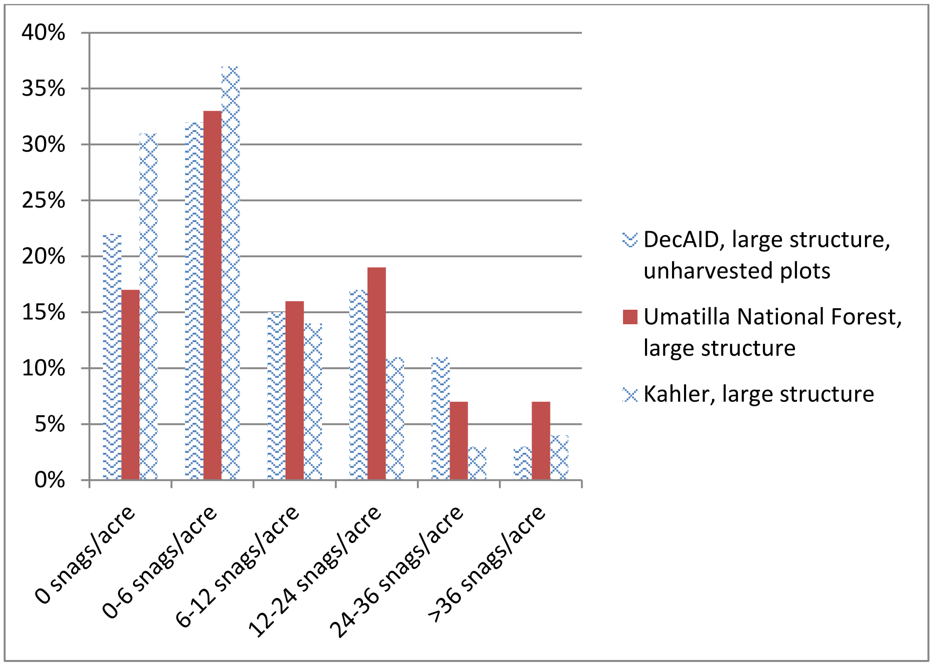

Figure W-17. Distribution of snags (% of the area) ≥10 inches DBH in the Eastside Mixed Conifer/Blue Mountains DecAID habitat type.

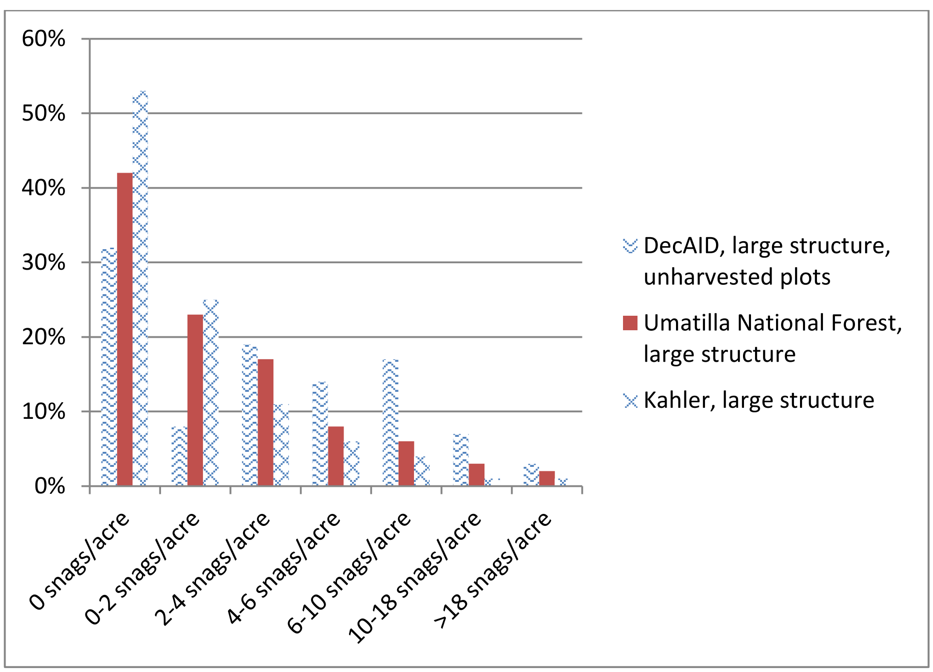

Figure W-18. Distribution of snags (% of the area) ≥20 inches DBH in the Eastside Mixed Conifer/Blue Mountains DecAID habitat type.

In the ≥10 inch group, there is currently much more area in the Kahler analysis area with zero snags/acre and less area with 12 to 24 and 24 to 36 snags/acre than would be expected to occur under the reference condition. In the ≥20 inch group, there is currently much more area in the Kahler analysis area and the Umatilla National Forest that currently has zero and zero to 2 snags/acre than would be expected under the reference condition. There is also a lower proportion of the Kahler analysis area and Umatilla National Forest that has 2 to 4, 4 to 6, 6 to 10, and 10 to 18 snags/acre than would be expected under the reference condition.

Table W-25. Proportion of habitat area that lies within tolerance intervals for the pileated woodpecker, Eastside Mixed Conifer/Blues forest type, snags ≥20 inches.

Snags/Acre ≥20 in. DBH	**0-3.5**	**3.5-7.8**	**7.8-18.4**	**(>18.4)**
PIWO Tolerance Level / **Wildlife Habitat Type**	**<30% tl**	**30-50% tl**	**50-80% tl**	**>80% tl**
	Percent of landscape			
DecAID – Eastside Mixed Con./Blue Mtns, unharvested plots, large structure	54	26	17	3
Umatilla National Forest, large structure	78	15	6	2
Kahler Analysis Area, large structure	86	11	3	1

Table W-25 indicates that the Umatilla National Forest and the Kahler Analysis Area are providing less area (lower proportion) of EMC/Blues habitat in the 30-50% and 50-80% tolerance level range than would be expected under the DecAID reference condition. The Kahler area is also providing substantially more area in the zero-30% tolerance level range, and a similar amount of EMC_ECB habitat in excess of the 80% tolerance level when compared to the DecAID reference condition.

Wisdom et al. (2000) defined habitat requirements (source habitats) and assessed broad-scale trends of 91 species of terrestrial vertebrates within the Interior Columbia Basin, including that of the pileated woodpecker. They evaluated change in source habitat from pre-European settlement (historical, circa 1850-1890) to current (circa 1985-1995) conditions for each species and for hierarchically nested groups of species and families of groups for which habitat could be estimated reliably using a large mapping unit (pixel size of 100 hectares [247 acres]). Source habitats are defined as those characteristics of macro-vegetation (vegetation that can be measured accurately using 100 hectare [247 acres] pixel) that contribute to stationary or positive population growth for a species in a specified area and time and to long-term population persistence. Source habitats contribute to source environments, which represent the composite of all environmental conditions that result in stationary or positive population growth for a species in a specified area and time. Source habitats are distinguished from habitats simply associated with species occurrence; species occurrence by itself does little to indicate the capability of the environment to support long-term persistence of populations (Wisdom et al. 2000). Pileated woodpecker source habitat (based on structure and composition) includes late-seral stages of the subalpine, montane, and lower montane forests (Wisdom et al. 2000), in particular the old-forest single- and multi-strata stages of grand fir-white-fir, interior Douglas-fir, western larch, western white pine, western red cedar-western hemlock; and the old-forest multi-strata stage of Engelmann spruce-subalpine fir, Pacific silver fir-mountain hemlock (Wisdom et al. 2000). The pileated woodpecker is a member of Group 6, which includes other species with similar habitat requirements and thus would be an "indicator" for these species. These other species include: Vaux's swift, Williamson's sapsucker, Hammond's flycatcher, chestnut-backed chickadee, brown creeper, winter wren, golden-crowned kinglet, varied thrush, silver-haired bat, and hoary bat. Wisdom et al. (2000) indicates that 4% of the Blue Mountains Ecological Reporting Unit (ERU) was historically pileated woodpecker source habitat (Wisdom et al. 2000, Volume 3, Table 5, pg. 494). Currently, 17.04% of the Blue Mountains ERU is considered source habitat, a relative change of >100 percent (Wisdom et al. 2000, Volume 1, pg 33). Densities of large-diameter snags (>21 inches dbh), which are important habitat components for pileated woodpeckers, have declined basin-wide from historical to current levels (Wisdom et al. 2000, Korol et al. 2002).

Wales et al. (2011) analyzed source habitat of numerous wildlife species of interest in the Blue Mountains and the Umatilla National Forest in support of the Blue Mountains Forest Plan Revision. Methods used were similar to the analysis conducted in the *Source Habitats for Terrestrial Vertebrates of Focus in the Interior Columbia Basin* (Wisdom et al. 2000). The analysis was conducted on National Forest lands, using vegetation data from stand exams, photo interpretation, and satellite imagery. The analysis was conducted at the stand-scale, a finer scale than the source habitat analysis conducted by Wisdom et al. (2000). The current amount of source habitat (existing condition) on the Forest was identified by using four variables; potential vegetation group, canopy closure, number of canopy layers, and tree size. Refer to the project file for source habitat definitions applied to the Forest and Kahler Analysis Area. Currently, there are approximately 213,445 acres of pileated woodpecker source habitat on the Umatilla National Forest (Wales et al. 2011). In general, habitat appears to be well distributed across the Forest. Areas predominantly composed of ponderosa pine and open grasslands (which comprise a considerable portion of the Forest) do not constitute source habitat for this species. This level of source habitat would provide adequate habitat (quantity and quality) for approximately 200 pairs of pileated woodpeckers at the Forest scale, based on the assumption that mean home range size is approximately 1,000 acres per pair (Bull and Holthausen 1993). Within the Kahler analysis area, there are currently 3,550 acres of pileated woodpecker source habitat, which is less than two percent (1.6%) of the source habitat available at the Forest scale. This habitat would support approximately 3 to 4 nesting pairs of pileated woodpecker. Pileated woodpecker source habitat within the Kahler analysis area is spread throughout the project area, with the exception of the Wheeler Point Fire area. This species is known to nest in the analysis area. Several active nests as well as a number of aural and visual observations were made during reconnaissance of the project area.

A species viability assessment was conducted for the pileated woodpecker in the Blue Mountain region of northeast Oregon and Washington, as well as for the Umatilla National Forest following Regional guidance (Wales et al. 2011). The assessment process is based on using the concept of Historic Range of Variability (HRV) to assess likelihood of maintaining viable populations of species (Suring et al. 2011). It is assumed that if the amount of habitat available is within the HRV that there is adequate habitat to ensure population viability since species persisted with those levels of habitat from the past to the present day (Landres et al. 1999). Viability outcome probabilities and an explanation of viability classes (A-E) are described in Table W-26 below.

Table W-26. Viability Outcome Classes and Percent Probability of Outcome for the Pileated Woodpecker on the Umatilla National Forest.

Viability Outcome Class	Definition(s) (Raphael et al. 2001)	Percent Probability of Outcome	
		Historic	Current
A	Suitable environments are broadly distributed and of high abundance. The combination of distribution and abundance of environmental conditions provides opportunity for continuous or nearly continuous intra-specific interactions for the focal species. Focal species with this outcome are likely well-distributed throughout the planning area.	80	30
B	Suitable environments are broadly distributed and of high abundance, but there are gaps where suitable environments are absent or only present in low abundance. However, the disjunct areas of suitable environments are typically large enough and close enough to permit dispersal among subpopulations and to allow the species to potentially interact as a metapopulation. Species with this outcome are likely well-distributed throughout most of the planning area.	14	55
C	Suitable environments are distributed frequently as patches and/or exist at low abundance. Gaps where suitable environments are either absent or present in low abundance are large enough such that some subpopulations are isolated, limiting opportunity for intra-specific interactions. There is opportunity for subpopulations in most of the planning area to interact, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition, reduction in the species' range in the planning area may have resulted. Focal species with this outcome are likely well-distributed in only a portion of the planning area.	5	10
D	Suitable environments are frequently isolated and/or exist at very low abundance. While some of the subpopulations associated with these environments may be self-sustaining, there is limited opportunity for population interactions among many of the suitable environmental patches. For species for which this is not the historical condition, reduction in species' range in the planning area may have resulted. These species are likely not well-distributed in the planning area.	1	5
E	Suitable environments are highly isolated and exist at very low abundance, with little or no possibility of population interactions among suitable environmental patches, resulting in strong potential for extirpations within many of the patches, and little likelihood of recolonization of such patches. There has likely been a reduction in the species' range from historical conditions, except for some rare, local endemics that may have persisted in this condition since the historical time period. Focal species with this outcome are not well-distributed throughout much of the planning area.	0	0

Historically, it is most probable (80% probability), that pileated woodpecker source habitat was broadly distributed and of high abundance, and that the pileated woodpecker was likely well distributed throughout the Umatilla National Forest. The abundance and distribution of habitat was such that there was opportunity for continuous or nearly continuous interaction of the species (Outcome A).

Currently, habitat of the pileated woodpecker is less abundant and less contiguous than historical conditions. Currently, it is most probable (55% probability) that habitat of the pileated woodpecker is broadly distributed and of high abundance, with scattered gaps. Suitable habitats are large enough and close enough together to permit dispersal and interaction between patches separated by unsuitable habitat. A 55% probability of Outcome B indicates that this species is likely well distributed throughout most of the planning area (Umatilla National Forest). The results of the viability analysis indicate that the Umatilla National Forest currently provides for the viability of the pileated woodpecker. The pileated woodpecker is distributed across the Umatilla National Forest and there are adequate amounts, quality, and distribution of habitat to provide for pileated woodpecker population viability.

ENVIRONMENTAL CONSEQUENCES

No Action

Direct and Indirect Effects

In the short term, pileated woodpecker source habitat would maintain its current quality and extent in the analysis area. In the mid and long term (5 to 15+ years), the structure and composition of pileated woodpecker habitat would change. In this time frame, multi-strata conditions in pileated woodpecker source habitat would continue to develop; stand densities would increase, and locally high concentrations of insects and disease would provide foraging and nesting habitat by creating snags. Young dry and moist upland forest stands in an unsuitable condition for pileated woodpecker foraging or nesting would also develop multi-strata characteristics in the mid and long term, increasing the amount of source habitat in the analysis area and improving its distribution. Higher stand densities and increased standing and downed fuel loads would increase the risk of high severity wildfire in these stands. While it is expected that mixed severity fire would occur, there would be larger patches of high severity impacts (due to higher flame lengths and resulting passive crown fire) than would have been expected historically. High-severity effects (high overstory mortality) would change the composition and structure of pileated woodpecker source habitat to an open shrubland/grassland with little or no tree cover and cause fragmentation of existing habitat. Pileated would be unlikely to use these habitats due to their structure and composition. This condition would last for as long as 80-100 years as stands reseeded themselves, and grew into a structural stage and size class that would provide snags large enough for nest cavities and foraging activity.

Common to All Action Alternatives

Direct and Indirect Effects

Dedicated Old Growth (management area C1) habitat would be affected in the vicinity of Tamarack Lookout. Vegetative treatment would occur within 12 acres of existing DOG 1841 to protect the Lookout and other infrastructure from wildfire and clear sight lines from the lookout. These acres would be moved from the C1 management area allocation to the E1 management area allocation under this project; 16 acres adjacent to DOG 1841 would be moved from the E1 management area into the C1 allocation. The replacement acres currently show evidence of pileated woodpecker use, and are similar in structure and composition to those acres adjacent to the lookout that would be treated. As there would be a net increase of 4 acres in the C1 management area, and these acres are similar in structure and composition to those proposed for treatment, it is not expected that this activity will appreciably impact pileated woodpecker that are present in the stand. DOG 1841 would continue to provide for the survival and reproduction of the pileated woodpecker, and contribute to the viability of this species at the Forest scale. At the scale of the Forest, the dedicated old growth network (size/amount and distribution) would be maintained under both of the action alternatives. As a result, this project would be consistent with Forest Plan direction and guidance for the C1 management area.

Proposed commercial harvest (with skips and gaps), shrub steppe enhancement treatments, burning of activity and natural fuels, and hazard/danger tree felling activities under all of the action alternatives would have the same general effects on pileated woodpecker habitat; only the extent of the various treatments and activities would vary by alternative. Since pileated woodpecker habitat would be impacted by these activities to some extent, it stands to reason that an increase in the acres (or miles) impacted by these activities would have a greater impact on the pileated woodpecker and its habitat.

Snags ≥10 inches dbh would not be affected in treatment units except where individual snags pose a hazard to workers. Snags would be retained to the greatest degree possible given safety concerns. Where snags are felled to meet operational requirements for safety, all snags ≥12 inches dbh would be left on the ground to contribute toward downed wood densities. Monitoring elsewhere on the south end of the Umatilla National Forest has found that danger tree felling impacts a small percentage (4% to 6%) of the existing snags within commercially treated stands (Wildcat II Timber Sale, Scarlett 2011). Because snag densities would largely be maintained in commercially thinned stands, it is expected that pileated woodpecker would continue to utilize snag and downed wood habitat in these areas following implementation. It is expected that foraging would occur at lower levels than currently may occur due to reductions in canopy closure and complexity; the majority of use would be expected to occur at the fringes of these stands. See the *MIS: Primary Cavity Excavator* section for a full discussion of the impacts of the alternatives on standing dead wood habitat. Refer to Table W-27 for acres of treatment within pileated woodpecker source habitat by treatment type.

Table W-27. Expected effects on pileated woodpecker source habitat by treatment type.

Alternative	Source Habitat Treated (acres)	Treatment Type	
		Commercial Thinning (with skips and gaps)	Shrub Steppe Enhancement
Alternative 2	2,348	2,328	20
Alternative 3	1,994	1,974	20
Alternative 4	1,675	1,655	20

It is likely that commercially thinned stands would not be used for nesting after treatment (in the short and early long term) due to reductions in canopy density. These stands would be used less by foraging pileated woodpecker due to this reduction in canopy density and shift in the context of the stand from more dense to more open habitat. After treatment, the structure and composition of these dry forest PVG stands would be more representative of what would have been present historically. In the long term, treated stands would likely be used for nesting as canopy density increases, larger trees develop, and larger snags and downed wood are recruited. Untreated skips within commercially thinned stands would provide for within-stand heterogeneity and dense pockets where endemic or greater insect and disease may occur. Due to the size of these skips (generally 0.5 to 2 acres with some larger where vegetation and other factors make this appropriate) and the density of the surrounding post-treatment forest matrix, it is unlikely that these skips would be used for nesting. Foraging would likely occur in these patches, especially where they are in close proximity to untreated dry and moist upland forest stands with high canopy closure.

Under all of the action alternatives, ground-based mechanical thinning to improve steppe-shrubland habitat would occur. Shrub-steppe enhancement treatments would impact areas where historic shrublands and grasslands have been encroached by conifers, including juniper, ponderosa pine, and Douglas-fir. These areas would be quite open after treatment; only old, large trees would be retained in the overstory. These areas would not be used for nesting following treatment; potential foraging would likely be greatly reduced in these stands. Approximately 20 acres of source habitat would be affected in steppe-shrubland units under each of the action alternatives.

Landscape underburning under all of the action alternatives would affect snags and downed wood (particularly smaller diameter material and those in later stages of decay) over the same area, 31,000 acres. The potential loss of medium and large diameter dead standing trees from landscape and activity fuels burning is expected to be minimal based on the impacts of similar activities in similar habitat types (Harrod et al. 2009, Hessburg et al. 2010). Thies and others (2008) found that as much as 5% of existing large diameter green trees may be killed by immediate and delayed fire impacts. Stand structure would not be affected by landscape underburning or activity fuels burning (Harrod et al. 2009). Charring of downed wood and snags would reduce the abundance of ants utilizing these structural elements, reducing potential forage for this species. Overall, underburning is expected to have minor impacts on forage (ant) availability due to the intensity, timing, and mosaic nature of proposed underburns.

New system road construction and temporary road construction/use (new temporary roads and existing temporary roads) would not measurably impact the pileated woodpecker or source habitat. New road construction would generally occur in existing openings; impacts to overstory vegetation would be minor. Danger tree felling along and adjacent to haul routes (including open, closed, seasonal, new system road, new temporary roads, and existing temporary roads) may impact snags and green trees. This activity would reduce potential nesting and foraging sites adjacent to these roads. The footprint of new temporary roads would exist for a number of years; in the long term, these areas would be re-seeded by trees and shrubs, filling in openings. Pileated woodpeckers would readily cross them; they would not increase fragmentation of pileated habitat. Danger tree felling along open roads and closed system roads used to access treatment units would also impact snags to a small degree. Due to the linear nature of roads and associated danger tree felling, the impact is expected to be minor. All large diameter (≥20 inches) danger trees that are felled would be retained to provide downed woody material for wildlife.

Cumulative Effects

Refer to the primary cavity excavator section for discussion of the cumulative impacts of the proposed alternatives on snag habitat within the Kahler snag analysis area. Past activities, actions, and events in the Kahler analysis area that have impacted pileated woodpecker source habitat include timber harvest (9,640 acres since 1975), wildfire (Wheeler Point Fire), fire suppression, firewood gathering, and insect and disease activity. Past harvest activities impacted the quality, quantity, and distribution of pileated woodpecker source habitat. These activities altered stand structure, reducing the amount of late and old structure habitat in the analysis area, and the size of available habitat patches in the already dry upland forest-dominated analysis area. Large trees were generally targeted in these stands. In general, commercially thinned, regeneration harvested, and overstory removal stands are not currently providing source habitat or late and old structure habitat features desired by this species. These activities also reduced potential recruitment of snags by removing green trees. Firewood gathering has also reduced snag densities (<24 inches measured 1 foot above the ground) adjacent to open roads, in accordance with the terms and conditions of personal use firewood permits. Past wildfire also reduced the amount of source habitat within the analysis area. High and moderate severity portions of the Wheeler Point Fire are not typically used by the pileated woodpecker due to the lack of overstory canopy cover. Fire suppression has allowed for the ingrowth of shade-tolerant vegetation in dry upland forest stands, increasing canopy density and stand complexity (multiple layers). Pileated woodpecker are currently using some dry forest stands that historically would have been open, single-stratum stands. Insect outbreaks (spruce budworm) have resulted in patchy mortality of grand fir and Douglas-fir in the analysis area. As a result, there are scattered stands with high snag densities. These activities have combined to create the existing condition of pileated woodpecker habitat in the analysis area.

There are currently no ongoing or reasonably foreseeable future activities, actions, and events in the analysis area (other than personal use firewood gathering) that would affect pileated woodpecker source habitat.

When the expected effects of these alternatives are combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be an incremental reduction in source habitat and potential nesting, foraging, and roosting structures under all of the action alternatives. The abundance and distribution of the pileated woodpecker may be impacted under the proposed action alternatives due to impacts (reduced quantity, quality, and distribution of source habitat) associated with proposed vegetative treatments. Refer to individual alternative discussions for details. Hazard tree felling, danger tree abatement along roads, and burning would impact snags to some degree. It is expected that this cumulative impact would be minor given burning conditions, and Project Design Criteria (see EA Chapter 2) that will be implemented to protect snags within treatment units and along open, closed, and temporary roads used to access the project area. Density reduction would reduce future recruitment of snags (primarily smaller diameter) resulting from density-dependent factors by an unknown degree. It is possible that these stands may fall below Forest Plan standards in the long term as lower recruitment in affected dry forest stands fails to keep pace with the rate at which existing snags decay and fall. In the long term, it is expected that as vegetation within treated stands develops (higher density, larger trees, higher crown closure, etc.), and moves towards a source habitat condition, snag recruitment would also increase, and Forest Plan standards would again be met. The proposed activities would generally occur in dry forest habitat. Treated stands would move toward a more appropriate (expected historically to occur in greater abundance that the existing state) dry forest structure and composition.

Alternative 2

Direct and Indirect Effects

The effects under this alternative would be similar to those described under *Common to All Action Alternatives*. This alternative would commercially thin the most acres of pileated woodpecker source habitat when compared to the other action alternatives. This alternative would therefore have the greatest impact on pileated woodpecker and their habitat in the short, mid, and long term. This alternative would impact approximately 2,348 acres of pileated woodpecker source habitat. This represents approximately 66% of the existing pileated woodpecker habitat in the analysis area. Due to the fragmented nature of the analysis area, the dominance of dry upland forest stands containing high proportions of ponderosa pine, and the fact that pileated source habitat is spread throughout the analysis area, it is likely that the affected acres represent a number of individual territories. This level of impact equates to 1% of the source habitat across the Forest. The distribution of pileated woodpecker source habitat would be impacted to a high degree under this alternative. Source habitat that remains would largely be in narrow strips along riparian areas, in C1 old growth stands, and in a few moist and cold stands dropped from consideration during project development. Some concentrations of pileated woodpecker source habitat would be completely converted to an unsuitable condition for nesting. It is likely that overall use of the area would be reduced due to this reduction in the quantity, size, and distribution of pileated woodpecker source habitat.

This alternative would require the most miles of closed road, seasonal road, and existing temporary roads when compared to the other alternatives; as a result, the impacts to existing snags adjacent to roads would be greatest under this alternative.

Cumulative Effects

The cumulative effects under this alternative would be similar to those described under *Common to All Action Alternatives*. When the expected effects of this alternative are combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be incremental reduction in the quantity, quality, and patch size of source habitat. This alternative would also contribute to fragmentation of pileated source habitat by affecting the landscape distribution of source habitat. Hazard and danger tree abatement and vegetative treatment would also contribute to past losses in standing dead wood habitat, reducing potential roosting, foraging, and nesting habitat for this species. It is likely that pileated woodpecker may use the Kahler Project area less after harvest due to impacts to the quality and quantity of source habitat, the landscape distribution of these habitats, and short and long term direct and indirect impacts to standing dead wood. This alternative would have a greater cumulative impact on this species than the other action alternatives.

Forest Plan Consistency

Because the Kahler Dry Forest Restoration Project would impact approximately 1% of the pileated source habitat on the forest, the overall direct, indirect, and cumulative effects would result in a small negative habitat trend at the Forest scale. This impact to habitat would be insignificant at the scale of the Umatilla National Forest. At the Forest scale, impacts associated with implementation of Alternative 2 would not result in short or long term population reductions due to the size of the affected area, and the expected level of impact to source habitat. C1 Dedicated Old Growth habitat would be revised (through a Forest Plan amendment) to allow for protection of Tamarack Lookout, Tamarack cabin, communication infrastructure, and to clear sight lines from the tower. The size and distribution of C1 old growth habitat would provide for the survival and reproduction of the pileated woodpecker, and meet Forest Plan direction and guidance under this alternative. This management area would contribute to the viability of this species at the Forest scale. Existing dead wood habitat would be maintained at the highest levels possible in proposed treatment units, as only those snags that are a hazard to operators or a danger to road use would be felled. At the analysis area scale, it is expected that average snag densities would meet or exceed those required by the Forest Plan in the short long term. Snag densities may fall below Forest Plan minimum standards in some treatment units due to a reduction in density-dependent mortality. It is expected that the distribution of snag density classes in the snag analysis area (see Primary Cavity Excavator section, EMC/Blues habitat type) would change to a small degree. In the short and mid-term, there would be a decrease in the proportion of the analysis area providing moderate snag densities, primarily due to reduced snag recruitment. The snag density distribution would be expected to be similar to that expected under the reference condition provided by DecAID. For these reasons, the Kahler Project would be consistent with the Forest Plan as it relates to pileated woodpecker management; the continued viability of the pileated woodpecker is expected on the Umatilla National Forest under this alternative.

Alternative 3

Direct and Indirect Effects

This alternative would commercially thin fewer acres of source habitat than Alternative 2. As a result, potential impacts on the pileated woodpecker would be reduced under this alternative. This alternative would impact approximately 1,994 acres of pileated woodpecker source habitat, 354 acres less than Alternative 2. This represents approximately 56% of the existing pileated woodpecker source habitat in the analysis area. Due to the fragmented nature of the analysis area, the dominance of dry upland forest stands containing high proportions of ponderosa pine, and the fact that pileated source habitat is spread throughout the analysis area, it is likely that the affected acres represent a number of individual territories. This level of impact equates to approximately 1% of the source habitat across the Forest. The distribution of pileated woodpecker source habitat would be impacted to a lesser degree under Alternative 3 than Alternative 2. Under Alternative 3, source habitat patches ranging in size from 15 to 100 acres would be dropped from commercial harvest to maintain high density dry and moist upland forest stands distributed across the landscape (in addition to narrow strips along riparian areas, patches in C1 old growth stands, and patches in a few moist and cold stands dropped from consideration during project development). Some concentrations of pileated woodpecker source habitat would be largely converted to an unsuitable nesting condition. It is likely that overall use of the area would be reduced to some degree due to this reduction in the quantity, patch size, and distribution of pileated woodpecker source habitat. This impact is expected to be less than would occur under Alternative 2.

Cumulative Effects

The cumulative effects under this alternative would be similar to those described under *All Action Alternatives*. Alternative 3 would contribute to past reductions in pileated woodpecker habitat (quantity, quality, and distribution across the landscape) by converting source habitat to an unsuitable condition. Alternative 3 would have slightly less cumulative impact on pileated woodpecker source habitat than would Alternative 2. Under this alternative, retention of larger patches of suitable habitat distributed across the landscape would reduce the impact associated with extensive harvesting proposed under Alternative 2. Use of the post-harvest landscape by pileated woodpecker would be reduced to some degree under this alternative; however, this species would continue to persist in the Kahler analysis area post-implementation.

Forest Plan Consistency

Alternative 3 would impact approximately 1% of the pileated source habitat on the forest. The overall direct, indirect, and cumulative effects would result in a small negative habitat trend at the Forest scale. This impact to habitat would be insignificant at the scale of the Umatilla National Forest. At the Forest scale, impacts associated with implementation of Alternative 3 would not result in short or long term population reductions due to the size of the affected area, and the expected level of impact to source habitat. C1 Dedicated Old Growth habitat would be revised (through a Forest Plan amendment) to allow for protection of Tamarack Lookout, Tamarack cabin, communication infrastructure, and clear sight lines from the tower. The size and distribution of C1 old growth habitat would provide for the survival and reproduction of the pileated woodpecker, and meet Forest Plan direction and guidance under this alternative. This management area would contribute to the viability of this species at the Forest scale. Dead wood habitat would be maintained at the highest levels possible in proposed treatment units, as only snags ≥10 inches dbh that are a hazard to operators or a danger to road use would be felled. At the analysis area scale, it is expected that average snag densities would meet or exceed the Forest Plan standard in the short and long term. Snag densities may fall below Forest Plan minimum standards in some treatment units due to a reduction in density-dependent mortality. It is expected that the distribution of snag density classes in the snag analysis area (see Primary Cavity Excavator section, EMC/Blues habitat type) would change to a small degree. In the short and mid-term, there would be a decrease in the proportion of the analysis area providing moderate snag densities, primarily due to reduced snag recruitment. The snag density distribution would be expected to be similar to that expected under the reference or historic conditions. For these reasons, the Kahler Project would be consistent with the Forest Plan as it relates to pileated woodpecker management; the continued viability of the pileated woodpecker is expected on the Umatilla National Forest under this alternative.

Alternative 4

Direct and Indirect Effects

This alternative would commercially thin fewer acres of source habitat (1,675) than Alternatives 2 and 3. As a result, potential impacts on the pileated woodpecker would be the least under this alternative. This alternative would impact 673 acres less than Alternative 2 and 319 acres less than Alternative 3. This represents approximately 47% of the existing pileated woodpecker source habitat in the analysis area. Due to the fragmented nature of the analysis area, the dominance of dry upland forest stands containing high proportions of ponderosa pine, and the fact that pileated source habitat is spread throughout the analysis area, it is likely that the affected acres represent a number of individual territories. This level of impact equates to less than 1% of the source habitat across the Forest. The distribution of pileated woodpecker source habitat would be impacted to a lesser degree under Alternative 4 than the other two action alternatives. In addition to source habitat patches that would be dropped from commercial harvest to maintain high density dry and moist upland forest stands under Alternative 3, this alternative would also drop all Class IV RHCAs and some areas accessible only by new temporary roads from treatment. As was the case under Alternatives 2 and 3, some concentrations of pileated woodpecker source habitat would be largely converted to an unsuitable nesting condition. It is likely that overall use of the area would be reduced to some degree due to this reduction in the quantity, patch size, and distribution of pileated woodpecker source habitat. This impact is expected to be less than would occur under Alternatives 2 and 3.

Cumulative Effects

The cumulative effects under this alternative would be similar to those described under *All Action Alternatives*. Alternative 4 would contribute to past reductions in pileated woodpecker habitat (quantity, quality, and distribution across the landscape) by converting source habitat to an unsuitable condition. However, Alternative 4 would have less cumulative impact on pileated woodpecker source habitat than the other action alternatives. Under this alternative, retention of more source habitat distributed across the landscape would reduce expected impacts associated with extensive harvesting proposed under Alternatives 2 and 3. Use of the post-harvest landscape by pileated woodpecker would be reduced to some degree under this alternative; however, this species would continue to persist in the Kahler analysis area post-implementation.

Forest Plan Consistency

Alternative 4 would impact less than 1% of the pileated source habitat on the forest. The overall direct, indirect, and cumulative effects would result in a small negative habitat trend at the Forest scale. This impact to habitat would be insignificant at the scale of the Umatilla National Forest. At the Forest scale, impacts associated with implementation of Alternative 4 would not result in short or long term population reductions due to the size of the affected area, and the expected level of impact to source habitat. C1 Dedicated Old Growth habitat would be revised (through a Forest Plan amendment) to allow for protection of Tamarack Lookout, Tamarack cabin, communication infrastructure, and clear sight lines from the tower. The size and distribution of

C1 old growth habitat would provide for the survival and reproduction of the pileated woodpecker, and meet Forest Plan direction and guidance under this alternative. This management area would contribute to the viability of this species at the Forest scale. Dead wood habitat would be maintained at the highest levels possible in proposed treatment units, as only snags ≥10 inches dbh that are a hazard to operators or a danger to road use would be felled. At the analysis area scale, it is expected that average snag densities would meet or exceed the Forest Plan standard in the short and long term. Snag densities may fall below Forest Plan minimum standards in some treatment units due to a reduction in density-dependent mortality. Because this alternative would maintain the most acres of dense dry and moist upland forest in an unharvested condition, these impacts are expected to occur over a smaller area when compared to Alternatives 2 and 3. It is expected that the distribution of snag density classes in the snag analysis area (see Primary Cavity Excavator section, EMC/Blues habitat type) would change to a small degree. In the short and mid-term, there would be a decrease in the proportion of the analysis area providing moderate snag densities, primarily due to reduced snag recruitment. The snag density distribution would be expected to be similar to that expected under the reference or historic conditions. For these reasons, the Kahler Project would be consistent with the Forest Plan as it relates to pileated woodpecker management; the continued viability of the pileated woodpecker is expected on the Umatilla National Forest under this alternative.

AMERICAN MARTEN

AFFECTED ENVIRONMENT

The American marten was selected as a MIS to be an indicator of mature and old growth stands at high elevations. It is assumed that if good habitat is provided for American marten and their population is maintained at some desired level, that adequate habitat is also being provided for other species that share similar habitat requirements (USDA 1990, page 2-9). The Land and Resource Management Plan (USDA 1990) established Designated and Managed Old Growth stands (Management Areas C1 and C2) to provide habitat for the American marten and other old growth associated species. All existing old growth forest habitat on the Umatilla was identified/inventoried and mapped on aerial photos by Ranger District personnel. Specific units were then designated and mapped to meet the minimum size and distributional requirements for MIS (Forest Process Document No. 118; 1990). For marten, the Forest Plan calls for individual habitat units of 160 contiguous acres in later seral stages (V or VI) with a crown closure of at least 50 percent distributed throughout the forest in suitable habitats so that there is at least one habitat area every 4,000 to 5,000 acres of capable habitat. In all, 80,275 acres of old growth habitat on the Umatilla National Forest were set aside as management areas C1 and C2, with American marten suitable and capable old growth habitat accounting for 33,944 acres of this total. These acres were allocated with the intention to maintain habitat diversity, preserve aesthetic values, and provide old-growth habitat for wildlife. The rationale for developing the Old Growth (C1 and C2) Units (grid) on the Forest states that "*The assumptions, calculations, and /or guidelines meet Regional Office and Forest planning direction. These procedures also provide the rationale for designating the old growth/mature tree habitat units on the Forest….and summarizes the habitat needed to maintain viable populations of management indicator species"* (Forest Process Document No. 118 1990). These management areas were designed to serve as the foundation for ensuring MIS population viability at the Forest scale.

The marten is distributed throughout Canada and Alaska, south through the Rockies, Sierra Nevada, northern Great Lakes Region, and northern New England. In Oregon and Washington, the marten is resident in montane forests of the southern Oregon Coast Range, Siskiyou

Mountains, Cascade Mountains, Blue Mountains, Olympic Peninsula, and northeast Washington (Verts and Carraway 1998). Marten are absent from the northern Oregon and southern Washington coastal mountains, and are rare in the Olympic Peninsula (Zielinski et al. 2001).

Martens exhibit a life-history strategy defined by having small litters, high longevity, and large spatial requirements relative to its body size and trophic level. American marten are typically associated with late-seral coniferous forests with closed canopies, large trees, and abundant snags and down woody material (Zielinski et al. 2001). Martens are closely associated with forested habitats that have complex physical structure near the ground (Bull et al. 2005b, Slauson et al. 2007). Martens are extremely susceptible to predation and are reluctant to venture into openings (Ruggiero et al. 1994). Martens seem to be sensitive to patch size, and usually avoid open habitats dominated by grasses, forbs, and saplings, especially in winter. Open areas, such as regeneration logging units, recent severely burned areas, and natural openings are avoided, especially during the winter. Forested riparian habitats are used disproportionately higher than they are available, which indicates their importance as travel corridors (Bull et al. 2005b, Buskirk et al. 1989). Source habitats (based on structure and composition) include subalpine and montane forests in old multi- and single-story, and unmanaged young multi-story structural stages (Wisdom et al. 2000, Appendix 1, Table 1). In the Blue Mountains, stands used by marten had higher densities of large snags (>20 inches dbh) and trees > 10 inches dbh. They selected unharvested, closed canopy (50-75%), old-structure stands in subalpine fir and spruce forests. Martens were located closer to water than available plots. Northern aspects in upper slopes and drainages were selected for (Bull et al. 2005b). Slauson et al. (2007) also found that larger patch sizes of habitat were important for marten occurrence. In the Blue Mountains of northeastern Oregon, Bull et al. (2005b) found density of potential rest sites was significantly higher in marten home ranges than unoccupied areas. Generally, more habitat, larger patch sizes, and larger areas of interior forest were important predictors of occurrence (Chapin et al. 1998, Hargis et al. 1999, Kirk and Zielinski 2009). Because marten avoid openings and prefer larger forest patches (Chapin et al.1998 and Hargis et al.1999), habitat fragmentation may lead to isolation of local populations too small for long term viability. Hargis et al. (1999) reported that martens were rarely found in landscapes with >25% open (natural openings and clearcuts) and Chapin et al. (1998) found no adult female territories in landscapes with >31% of mature forest cover removed.

Marten have large home ranges, considering their body size (Buskirk and Ruggiero 1994). The mean home range size for marten in northeast Oregon ranged from 3,498 acres for females to 6,710 acres for males (Bull and Heater 2001a). Home range overlap was very small for same-sex neighbors, but male territories overlapped female home ranges an average of 64%, while females' overlapped males' an average of 28%. In most studies males had home-range sizes 2 to 3 times that of females. Home-range size may change with population density, food abundance, and body size (Clark et al. 1987). Martens are generally solitary, except during the breeding season. There appears to be overlap in territories between sexes, but a high degree of territoriality exists between members of the same sex for both males and females (Bull and Heater 2001a). Bull and Heater (2001b) documented relatively high mortality of juveniles by adult martens.

Martens' primary prey includes voles, particularly red-backed voles. Other prey species include deer mice, squirrels, birds, shrews, chipmunks, bushy-tailed wood rats, snowshoe hares, and mountain cottontail rabbits (Bull 2000, Ruggiero et al. 1994). A key consideration for marten foraging is the structural complexity that supports a diverse prey base, provides for opportunities for marten to be successful in capturing prey, and allows for marten to hunt while minimizing their exposure to predation. Large down woody material, multiple canopy layers, high canopy closure, and over all higher structural complexity contribute to effective foraging habitat for marten.

Snags and down logs are identified as special habitat features of source habitat for the marten (Wisdom et al. 2000, Appendix 1, Table 2). During winter, martens will travel, hunt and rest in the subnivean environment. Complex structure near the ground in the form of course woody material, tree boles, and rocks create a network of spaces under the snow that martens can utilize. These conditions are more characteristic of moist and cold forest types where fire return intervals are greater, allowing time for dead wood to be recruited and accumulate. Down logs and snags also provide resting and denning sites for marten. The availability of quality denning sites likely increases the rates of survival and fecundity in marten (Raphael and Jones 1997). Large diameter downed logs and hollow trees (typically white fir and western larch) provide important resting and denning habitat (Bull and Heater 2000). In addition to providing rest and den sites, down wood is an important component of marten habitat because the primary prey of martens is small mammals associated with down wood. These small mammals include voles (*Microtus sp.*) red-backed voles (*Clethrionomys gapperi*), snowshoe hares (*Lepus americanus*) and squirrels in northeast Oregon (Bull and Blumton 1999, Bull 2000).

The movements of martens beyond home ranges through migration or dispersal have not been well studied (Buskirk and Ruggerio 1994). Juveniles generally disperse from the family group in late summer or early fall (Clark et al. 1987). Dispersal of young, and interchange of genetic material between individual marten in distant habitat patches are important considerations for the conservation of this species. Habitat used for dispersing or traveling may lack some of the components of source habitats, but typically have a canopy closure of greater than 50%, a large down woody component, and a relatively high density of trees (Bull et al. 2005b).

Threats to this species include loss/degradation of habitat due to timber harvest and wildfire in some areas (NatureServe 2014), loss of down wood (impacting prey availability and subnivean access) due to fuels reduction treatments (Bull and Blumton 1999), reductions in late-seral forest and associated large snags and logs (Wisdom et al. 2000), fragmentation of habitat (Wisdom et al. 2000, Hargis et al. 1999), fur trapping associated with road access (Wisdom et al. 2000), predation (Bull and Heater 2001b), reduced prey densities (Wisdom et al. 2000), and intraspecific competition/territorial interactions resulting in mortality (Bull and Heater 1995). Although trapping is a source of mortality for martens in the Blue Mountains, trapping records from ODFW do not reveal a significant number of martens being taken. Refer to the project file for a summary of trapping record data collected by the Oregon Department of Fish and Wildlife.

The conservation status of the American marten was identified at the global, national, and state of Oregon geographical areas by NatureServe; by listing status from Federal and State Threatened and Endangered Species lists and Sensitive Species lists; and by the Oregon Conservation Strategy. Table W-28 shows the current conservation status of the marten. In Oregon, this species is harvested as a fur-bearer state-wide.

Table W-28. Conservation Status of the American Marten.

NatureServe Status			Federal Status		State Status		Other	
Global Status	**National Status**	**State Status**	**Federally Listed, Proposed, Candidate, Delisted Species?**	**Regional Forester's Sensitive Species?**	**Threatened, Endangered, & Candidate Wildlife Species in Oregon?**	**ODFW Sensitive Species List (2008)?**	**Oregon Conservation Strategy**	**Oregon Furbearer, Game Mammal, Predator, Protected Non-game?**
*G5 -- Secur	*N5 -- Secure	*S3 -- Vulnerabl	Not listed	Not listed	Not listed	** Vulnerable	Strategy Species in	Fur bearer

e		e					the Blue Mountains Eco-region.	

* NatureServe conservation status ranks are based on a one to five scale, ranging from critically imperiled (1) to demonstrably secure (5). Status is assessed and documented at three distinct geographic scales-global (G), national (N), and state/province (S).

**The Oregon Department of Fish and Wildlife Sensitive Species List status of *Vulnerable* signifies that the species is facing one or more threats to their populations and/or habitats. Vulnerable species are not currently imperiled in a specific geographic area or the state, but could become so with continued or increased threats to populations and/or habitats.

Population trend information for Oregon is sparse. While the population trend of marten in the Blue Mountains and the Umatilla National Forest is not known, some information can be inferred from current habitat conditions, trapping records, and limited surveys that have occurred on the Umatilla National Forest. As discussed elsewhere in this assessment (Wisdom et al. 2000), marten habitat appears to exist in greater abundance currently than it did historically in much of the Blue Mountains. Theoretically a greater abundance of habitat is capable of supporting a larger population of martens. Although an increase in habitat abundance indicates that an increasing population trend is possible, there is not adequate data to support such a conclusion.

Wisdom et al. (2000) defined habitat requirements (source habitats) and assessed broad-scale trends of 91 species of terrestrial vertebrates within the Interior Columbia Basin, including that of the American marten. For a definition of source habitat, refer to the *Pileated Woodpecker* section of this report. American marten source habitat (based on structure and composition) include late-seral stages and unmanaged young stands in the subalpine and montane forest types (Wisdom et al. 2000), in particular the lodgepole pine, grand fir-white fir, interior Douglas-fir, western larch, Engelmann spruce-subalpine fir, western white pine, western red cedar-western hemlock, aspen, red fir, mountain hemlock, whitebark pine, Sierra Nevada mixed conifer, and Pacific silver fir-mountain hemlock forest communities (Wisdom et al. 2000). The American marten is a member of Group 5, which includes other species with similar habitat requirements and thus would be an "indicator" for these species. These other species include: northern goshawk (summer), flammulated owl, and fisher. Wisdom et al. (2000) indicates that 8.2% of the Blue Mountains Ecological Reporting Unit (ERU) was historically American marten source habitat (Wisdom et al. 2000, Volume 3, Table 5, pg. 493). Currently, 23.5% of the Blue Mountains ERU is considered source habitat, a relative change of >100 percent. Densities of large-diameter snags (>21 inches dbh), which are important habitat components for marten, have declined basin-wide from historical to current levels (Wisdom et al. 2000, Korol et al. 2002).

Wales et al. (2011) analyzed source habitat of numerous wildlife species of interest in the Blue Mountains and the Umatilla National Forest in support of the Blue Mountains Forest Plan Revision. The current amount of source habitat (existing condition) on the Forest was identified by using four variables; potential vegetation group, canopy closure, number of canopy layers, and tree size. Refer to the project file for source habitat definitions applied to the Forest and Kahler Analysis Area. Currently, there are approximately 113,933 acres of American marten source habitat on the Umatilla National Forest (Wales et al. 2011). In general, habitat appears to be well distributed across the Forest, with the largest proportion on the north end of the Forest. Areas predominantly composed of ponderosa pine and open grasslands (which comprise a considerable portion of the Forest) do not constitute source habitat for this species. Given an average territory size of 5,100 acres per individual (average of the mean for females and males), this level of source habitat would provide adequate habitat (quantity and quality) for approximately 22 individual marten at the Forest scale. This is a rough estimate due to the fact that there is some degree of territory overlap and no consideration given to the distribution of habitat on the Forest. Within the Kahler analysis area, there are currently 235 acres of marten source habitat, which is approximately 0.2% of the source habitat at the Forest scale. Due the quantity and distribution of source habitat in the analysis area, it is unlikely that this habitat would support marten. Habitat within the Kahler analysis area is located near the western edge of available habitat on the Forest. Within the Kahler Analysis Area, source habitat is largely restricted to scattered patches of moist and cold upland forest within the larger dry upland forest matrix. This species has not been observed in the analysis area. Surveys for this species have not occurred in the analysis area due to the dominant vegetative composition and structure of the area. Given the vegetative composition (primarily dry upland forest) and number of natural and man-made openings in the analysis area, it is unlikely that marten are currently present or would occur in the analysis area in the future.

A species viability assessment was conducted for the American marten in the Blue Mountain region of northeast Oregon and Washington, as well as for the Umatilla National Forest following Regional guidance (Wales et al. 2011). The assessment process is based on using the concept of Historic Range of Variability (HRV) to assess likelihood of maintaining viable populations of species (Suring et al. 2011). It is assumed that if the amount of habitat available is within the HRV that there is adequate habitat to ensure population viability since species persisted with those levels of habitat from the past to the present day (Landres et al. 1999). Viability outcome probabilities and an explanation of viability classes (A-E) are described in Table W-29 below.

Table W-29. Viability Outcome Classes and Percent Probability of Outcome for the American Marten on the Umatilla National Forest.

Viability Outcome Class	Definition(s) (Raphael et al. 2001)	Percent Probability of Outcome	
		Historic	Current
A	Suitable environments are broadly distributed and of high abundance. The combination of distribution and abundance of environmental conditions provides opportunity for continuous or nearly continuous intra-specific interactions for the focal species. Focal species with this outcome are likely well-distributed throughout the planning area.	69%	59%
B	Suitable environments are broadly distributed and of high abundance, but there are gaps where suitable environments are absent or only present in low abundance. However, the disjunct areas of suitable environments are typically large enough and close enough to permit dispersal among subpopulations and to allow the species to potentially interact as a metapopulation. Species with this outcome are likely well-distributed throughout most of the planning area.	23%	31%
C	Suitable environments are distributed frequently as patches and/or exist at low abundance. Gaps where suitable environments are either absent or present in low abundance are large enough such that some subpopulations are isolated, limiting opportunity for intra-specific interactions. There is opportunity for subpopulations in most of the planning area to interact, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition, reduction in the species' range in the planning area may have resulted. Focal species with this outcome are likely well-distributed in only a portion of the planning area.	6%	9%
D	Suitable environments are frequently isolated and/or exist at very low abundance. While some of the subpopulations associated with these environments may be self-sustaining, there is limited opportunity for population interactions among many of the suitable environmental patches. For species for which this is not the historical condition, reduction in species' range in the planning area may have resulted. These species are likely not well-distributed in the planning area.	2%	2%
E	Suitable environments are highly isolated and exist at very low abundance, with little or no possibility of population interactions among suitable environmental patches, resulting in strong potential for extirpations within	0%	0%

	many of the patches, and little likelihood of recolonization of such patches. There has likely been a reduction in the species' range from historical conditions, except for some rare, local endemics that may have persisted in this condition since the historical time period. Focal species with this outcome are not well-distributed throughout much of the planning area.		

Historically, it is most probable (69% probability) that marten habitat was broadly distributed and of high abundance, and that marten were well distributed within the mixed conifer forests of the Umatilla National Forest. The abundance and distribution of habitat likely provided for a high degree of connectivity within the elevations and forest cover types that provided source habitat for martens (viability outcome A). Currently, marten habitat is more abundant in some parts of the Blue Mountains and less abundant in others, but is generally less contiguous than under historic conditions. It is most probable (59% probability) that marten habitat is broadly distributed and of high abundance, and allows for continuous or nearly continuous intra-specific interactions for the focal species. The marten is likely well-distributed throughout the planning area (Umatilla National Forest) (viability outcome A). The results of this viability analysis indicate that the amount, quality, and distribution of habitat on the Umatilla National Forest provides for the viability of the marten at the Forest scale.

ENVIRONMENTAL CONSEQUENCES

No Action

Direct and Indirect Effects

In the short term (0 to 5 years), there would be no change in the quality or distribution of marten source habitat in the analysis area. In the mid (5 to 15 years) and long term (15+ years), the quality and distribution of marten habitat would likely change. In this time frame, old forest and young forest stands in the moist and cold upland forest PVGs would continue to develop multiple canopy layers and greater canopy density. Mortality resulting from insects and disease in stressed stands would increase snag and downed wood densities, improving the condition of foraging habitat for the marten. High fuel loading would increase the risk of high severity wildfire in these stands. High severity fire in moist and cold upland forest stands would cause heavy overstory mortality and consume downed wood used for denning and foraging. It would take upwards of 80-100 years for mixed conifer stands to develop a composition and structure that would provide marten source habitat after high severity wildfire.

Common to All Action Alternatives

Direct and Indirect Effects

The marten is not known or suspected to occur in the analysis area. Source habitat for this species is scarce and not contiguous, largely due to the fact that dry upland forest stands dominate the area, and this potential vegetation does not contribute to source habitat. As a result, there would be no direct or indirect impacts on this species. Approximately 12 acres of Dedicated Old Growth (management area C1) habitat would be moved into the E1 management area and 16 acres of E1 would become C1 through a Forest Plan Amendment. The affected stand (DOG 1841) is designated "Pileated Woodpecker Suitable"; it was not designated as marten "suitable" or "capable" old growth. The old growth network would continue to meet Forest Plan standards for size and distribution, and provide for the survival and reproduction of the marten, and contribute to the viability of the marten at the Forest scale.

Under Alternative 2, approximately 76 acres of marten source habitat would be commercially thinned. Under Alternative 3, approximately 54 acres of source habitat would be treated.

Alternative 4 would commercially thin approximately 49 acres of source habitat. These stands would not be considered source habitat after treatment due to reduced canopy closure and loss of stand complexity (multi-strata to single stratum). Under all of the action alternatives, this accounts for less than one-tenth of one percent of the marten source habitat on the Forest.

Landscape underburning is expected to have minor impacts on marten source habitat. Low intensity unberburns would not affect stand structure or composition and would have minimal impacts on large downed wood and snags within source habitat stands. Project Design Criteria (see EA Chapter 2) would be implemented that would protect source habitat and other moist and cold upland forest stands from undesired fire impacts.

Cumulative Effects

Past activities, actions, and events in the Kahler analysis area that have impacted marten source habitat include commercial thinning, regeneration harvest, and overstory removal (18,550acres since 1975), fire suppression, insect and disease outbreaks, and firewood cutting. Past harvest activities have impacted the quality, quantity, and distribution of marten source habitat to a small degree, and impacted dead wood. These activities reduced the amount of late and old structure habitat in the analysis area and fragmented larger late and old structure stands. In general, stands harvested in the past are not currently providing suitable source habitat or late and old structure habitat features desired by this species. These activities also reduced potential recruitment of snags by removing green trees. Fire suppression has allowed for the development of multiple canopy layers and dense overstory structure in moist and cold upland forest pockets within the analysis area. Insect outbreaks (spruce budworm) have resulted in high mortality of grand fir and Douglas-fir in some stands within the analysis area. These events had variable impacts on habitat quality for marten. Where canopy closure was reduced below the published preferences for this species, insect-affected stands would likely not be used for foraging or denning due to increased predation risk. Where overstory canopy closure was maintained to some extent, the resulting stands have high densities of dead wood that could be used for denning, resting, and foraging under snow. Past firewood cutting removed snags adjacent to open roads within the analysis area; it is unlikely that marten would have utilized these features due to their proximity to open roads. These activities have combined to create the existing condition of marten source habitat in the analysis area.

Present and reasonably foreseeable future activities, actions, and events that affect marten source habitat include firewood cutting. Firewood cutting is having similar effects as those described in the past activities section.

When the expected effects of all of the action alternatives are combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be a small incremental reduction in source habitat at the analysis area and Forest scale. The proposed vegetative treatment activities would generally occur in dry upland forest stands; treatment in these areas would not affect potential marten source habitat quality. Treatment in scattered moist and cold upland forest stands would reduce the quantity, quality, and distribution of marten source habitat. Since it is very unlikely that the marten is present in the analysis area due to the preponderance of dry forest habitat and the fragmented/scattered nature of moist and cold upland forest stands, it is not expected that the proposed activities would have an adverse cumulative impact on this species; it is not believed to be present in the analysis area.

Forest Plan Consistency (All Action Alternatives)

Under Alternatives 2, 3, and 4, the overall direct, indirect, and cumulative effects (resulting from commercial harvest and underburning) would result in a small negative habitat trend for the marten at the Forest scale. Under all of the action alternatives, less than one-tenth of one percent of the marten source habitat on the Forest would be impacted. This impact would be insignificant at the Forest scale. There would be no impacts on C1 Old Growth stands designated by the Land and Resource Plan (USDA 1990) to provide for the viability of the marten. The Kahler Project would therefore be consistent with the Forest Plan and the continued viability of the American marten is expected on the Umatilla National Forest.

AMERICAN THREE-TOED WOODPECKER

AFFECTED ENVIRONMENT

The American three-toed woodpecker (*Picoides dorsalis*) (formerly known as the northern three-toed woodpecker) was selected as a management indicator species in the Forest Plan to represent dead and down tree habitat in mature and old growth lodgepole pine stands (Table W-05). It is assumed that if good habitat is provided for three-toed woodpeckers and their population is maintained at some desired level, that adequate habitat is also being provided for other species that share similar habitat requirements (USDA 1990, page 2-9). The three-toed woodpecker plays an important ecological role by excavating nest cavities that are later used by other birds and small mammals (Thomas 1979) and by feeding on forest insect pests following fire and other disturbance such as insect infestations.

The Land and Resource Management Plan (USDA 1990) established Designated and Managed Old Growth stands (Management Areas C1 and C2) to provide habitat for the three-toed woodpeckers and other old growth associated species. For the three-toed woodpecker, the Forest Plan calls for individual habitat units of 75 acres in size in later seral stages (V or VI) distributed throughout the Forest so that generally every 2,000-2,500 acres of capable habitat contains at least one suitable habitat area. In all, 80,275 acres of old growth habitat on the Umatilla National Forest were set aside as management areas C1 and C2, with three-toed woodpecker suitable and capable old growth habitat accounting for 4,967 acres of this total. These acres were allocated with the intention to maintain habitat diversity, preserve aesthetic values, and provide old-growth habitat for wildlife. The rationale for developing the Old Growth (C1 and C2) Units (grid) on the Forest states that "*The assumptions, calculations, and /or guidelines meet Regional Office and Forest planning direction. These procedures also provide the rationale for designating the old growth/mature tree habitat units on the Forest….and summarizes the habitat needed to maintain viable populations of management indicator species"* (Forest Process Document No. 118 1990). These management areas were designed to serve as the foundation for ensuring MIS population viability at the Forest scale.

This species is a year-round resident throughout forested regions of Canada and Alaska, south into the northern New England states, Minnesota and Michigan, and south into Washington, Oregon, Idaho, and Montana, the Black Hills of South Dakota, Wyoming, Utah, Colorado, eastern Nevada, central Arizona, and southern New Mexico (Nature Serve 2014). The distribution of this species overlaps the distribution of spruce trees (Englemann spruce) almost perfectly (Marshall et al. 2003). This species appears to be rare, but occasionally abundant in Oregon, particularly near beetle outbreaks in the Cascade Mountains (Marshall et al. 2003). Reports from the Blue Mountains of Oregon are sparse. This species is present in higher elevation areas on the Umatilla National Forest. Preferred habitat for the American three-toed woodpecker includes late successional, cold and moist forest types (lodgepole/spruce/subalpine fir) with high standing-wood density (Marshall et al. 2003). Mixed conifer stands with a lodgepole pine component are also utilized, but to a much smaller degree (NatureServe 2014). They are also associated with recent stand replacing burns and other disturbances with high densities of bark beetles (Wisdom et al. 2000, Mellen-McLean et al. 2012). They primarily eat the larvae of mountain pine beetles in lodgepole pine and tend to prefer recently dead trees (Imbeau and Desrochers 2002). It is suggested that forest type may be less important in terms of presence/absence than the presence of bark beetles (Marshall et al. 2003). Most foraging occurs on large standing snags and dying trees. This species appears to prefer disturbed coniferous forests with trees that exhibit thin, flaky bark such as spruce and lodgepole pine. Goggans et al. (1988) suggests that 500 acres of mature/overmature lodgepole pine may be needed per pair of birds.

Standing dead trees (snags) are a special habitat feature utilized by this species. This species excavates cavities in dead and live trees (conifers and occasionally aspen) for nesting and roosting (NatureServe 2014), and foraging on dead and dying trees for bark beetles and wood boring insect larvae. Stands utilized by this species generally have high downed wood densities; this fact may be due to their preference for higher elevation lodgepole and spruce forest where insects and other disturbance (including past fire) create high downed wood densities.

The DecAID Advisor provides information on dead wood use by a large group of wildlife species, including the three-toed woodpecker. Due to the fact that Lodgepole Pine Forest is generally absent from the project area and unit acres except for isolated 30-meter pixels of this habitat type, only data from the Eastside Mixed Conifer/Blue Mountains habitat type is displayed here. Table W-30 below displays the snag density tolerance levels for the three-toed woodpecker in the Eastside Mixed Conifer/Blue Mountains habitat type in the ≥10 inch and ≥20 inch diameter groups for unburned (green) stands (no data available) and in the ≥3.15 inch and ≥20 inch diameter groups for burned (recent post-fire) stands. Snag densities derived from current vegetation survey data and gradient nearest neighbor modeling do not accurately depict snag densities in recently burned stands in the analysis area. No data is currently available to approximate this condition. The most recent large fire in the analysis area occurred in 2006 (Monument Fire). Approximately 250 acres of salvage harvest occurred in this fire area.

Table W-30. DecAID tolerance levels for snag density in the Eastside Mixed Conifer – Blue Mountains habitat type for the American three-toed woodpecker. DecAID Table EMC_PF.sp-23

30%, 50%, 80% tolerance levels for snag density (#/acre)			
Green Forests[1]		**Recent Post-fire[2]**	
>10” dbh	**>20” dbh**	**>3.15” dbh**	**>20” dbh**
No data	No data	44.4, 71.5, 111.6	No data

1 No data from studies occurring in green (live) stands in the Eastside Mixed Conifer – Blue Mountains habitat type is available for this species.
2 Data from Table EMC_PF.sp-23 for post-fire stands. Snag diameter for the data displayed above includes all snags 8 cm (3.15 in.) dbh or larger.

This species' and its large home range make it sensitive to logging and forest fragmentation (Leonard 2001). The practice of removing old growth lodgepole pine due to its infestation with the mountain pine beetle may reduce or eliminate habitat for this species (NatureServe 2014). Post-fire salvage also impacts potential habitat for this species by removing trees that would be attacked by its preferred forage, bark beetles. The conservation status of a species is an indicator of the likelihood of that species continuing to survive either in the present day or the future. The conservation status of the American three-toed woodpecker was identified at the global, national, and state of Oregon geographical areas by NatureServe; by listing status from Federal and State Threatened and Endangered Species lists and Sensitive Species lists; by the U.S. Fish and Wildlife Service *Birds of Conservation Concern;* by the Oregon Conservation Strategy; and by the Partners in Flight bird conservation Strategy - *Conservation Strategy for Landbirds in the Northern Rocky Mountains of Oregon and Washington*. Table W-31 displays the conservation status of the three-toed woodpecker.

Table W-31. Conservation Status of the American Three-toed Woodpecker.

NatureServe Status			Federal Status			State Status			Other
Global Status	National Status	State Status	Federally Listed, Proposed, Candidate, Delisted Species and Species of Concern	Regional Forester's Sensitive Species	USFWS Birds of Conserv. Concern	Threatened, Endangered, and Candidate Fish and Wildlife Species in Oregon	ODFW Sensitive Species List (2008)	Oregon Conserv. Strategy	Conservation Strategy for Landbirds in the Northern Rocky Mountains of Oregon and Washington
*G5--Secure	*N5--Secure	*S3--Vulnerable	Not listed.	Not listed.	Not listed.	Not listed.	**Vulnerable throughout Oregon.	Strategy Species in the Blue Mountains Eco-region.	Not a focal species

* NatureServe conservation status ranks are based on a one to five scale, ranging from critically imperiled (1) to demonstrably secure (5). Status is assessed and documented at three distinct geographic scales-global (G), national (N), and state/province (S).

**The Oregon Department of Fish and Wildlife Sensitive Species List status of Vulnerable signifies that the species are facing one or more threats to their populations and/or habitats. Vulnerable species are not currently imperiled with extirpation from a specific geographic area or the state but could become so with continued or increased threats to populations and/or habitats.

Three-toed woodpecker populations and trends are difficult to monitor because of their association with spatially unpredictable disturbance, such as fires and insect outbreaks. North American Breeding Bird Survey (BBS) data for 1980–1998 indicate a significant annual decrease in populations across the species' range in North America, however, this data should be viewed with caution given the low number of routes and low abundance of three-toed woodpeckers per route (Leonard 2001). The PIF Landbird Conservation Strategy, Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington (Altman 2000) addresses bird focal species and conservation issues and measures in the Blue Mountains. The American three-toed woodpecker is not identified as a focal species in the Conservation Strategy. The three-toed woodpecker is also not listed as a regional species of concern by the Partners in Flight database (http://www.rmbo.org/pif/scores/scores.html) for the Northern Rockies Bird Conservation Region (BCR 10).

Wisdom et al. (2000) defined habitat requirements (source habitats) and assessed broad-scale trends of 91 species of terrestrial vertebrates within the Interior Columbia Basin, including that of the American three-toed woodpecker. For a definition of source habitat, refer to the *Pileated Woodpecker* section of this report. Source habitats are distinguished from habitats simply associated with species occurrence; species occurrence by itself does little to indicate the capability of the environment to support long-term persistence of populations (Wisdom et al. 2000). American three-toed woodpecker source habitat (based on structure and composition) include late-seral stages in the subalpine and montane forest types (Wisdom et al. 2000), in particular the lodgepole pine, grand fir-white fir, Engelmann spruce-subalpine fir, mountain hemlock, and whitebark pine forest communities (Wisdom et al. 2000). The American three-toed woodpecker is part of Group 11, which includes species with similar habitat requirements and thus would be an "indicator" for these species. The only other species in this group is the white-winged crossbill. Wisdom et al. (2000) indicates that 4.2% of the Blue Mountains Ecological Reporting Unit (ERU) was historically three-toed woodpecker source habitat (Wisdom et al. 2000, Volume 3, Table 5, pg. 498). Wisdom et al. (2000) found that source habitats for Group 11 have declined moderately to strongly in greater than 50% of watersheds that contain suitable habitat. These changes were quite variable across the basin. Within the Blue Mountains ERU (ERU 6), a moderate to strongly increasing trend was present in greater than 50% of watersheds (Wisdom et al. 2000). Currently, 13.91% of the Blue Mountains ERU is considered source habitat, a relative change of >100 (Wisdom et al. 2000, Volume 1, pg 33).

The current amount of three-toed woodpecker source habitat (existing condition) on the Forest was identified by using four variables; potential vegetation group, cover type, canopy closure, and tree size. Refer to the project file for a description of source habitat queries applied to the Forest and Kahler analysis area. Currently, there are approximately 171,625 acres of source habitat on the Umatilla National Forest. In general, habitat appears to be well distributed across the Forest. Large gaps exist where lower elevation forests and grasslands bisect higher elevation areas potentially occupied by this species. This level of source habitat would provide adequate habitat (quantity and quality) for approximately 343 pairs of three-toed woodpeckers at the Forest scale, based on the assumption that mean home range size is approximately 500 acres per pair (Goggans et al. 1988). Within the Kahler analysis area, there are currently 235 acres of three-toed woodpecker source habitat, which is approximately 0.1% of the source habitat available at the Forest scale. This habitat would support less than one nesting pair of three-toed woodpecker. Habitat within the Kahler analysis area is located at the extreme western edge of available habitat on the Forest. The contribution of the habitat in the Kahler planning area for three-toed woodpeckers is extremely small at the Umatilla Forest scale. In addition, recent large fires on the forest have created large amounts of habitat elsewhere on the forest. Source habitat is scattered in small pockets within cold and moist forest stands lying within the larger dry upland forest matrix. No Managed Old Growth (management area C2) stands are present in the analysis area. No incidental observations of this species have been reported in the Kahler analysis area. Three-toed woodpecker distribution can be patchy and may change frequently as they follow the path of high-severity fires and insect outbreaks, making it very difficult to determine population trends.

ENVIRONMENTAL CONSEQUENCES

No Action

Direct and Indirect Effects

In the short term (0 to 5 years), there would be no change in the quality or distribution of three-toed woodpecker source habitat. In the mid (5 to 15 years) and long term (15+ years), the quality and distribution of habitat would likely change. In this time frame, stands in the moist and cold upland forest PVGs would continue to develop multiple canopy layers and greater canopy density. Mortality resulting from insects and disease in stressed stands would increase snag and downed wood densities, improving the condition of foraging and nesting habitat for the three-toed woodpecker. High fuel loading would increase the risk of high severity wildfire in these moist and cold upland forest stands. Habitat created by high severity fire would improve the local and landscape distribution of suitable foraging habitat for this fire-dependent species.

Common to All Action Alternatives

Direct and Indirect Effects

The three-toed woodpecker is not known or suspected to occur in the analysis area. Source habitat for this species is scarce and not contiguous, largely due to the fact that dry upland forest stands dominate the area, and this potential vegetation does not contribute to source habitat. As a result, there would be no direct or indirect impacts on this species. Approximately 12 acres of Dedicated Old Growth (management area C1) habitat would be moved into the E1 management area and 16 acres of E1 would become C1 through a Forest Plan Amendment. The affected stand (DOG 1841) is designated "Pileated Woodpecker Suitable"; it was not designated as three-toed woodpecker "suitable" or "capable" old growth. The old growth network would continue to meet Forest Plan standards for size and distribution, and provide for the survival and reproduction of the three-toed woodpecker, and contribute to the viability of the three-toed woodpecker at the Forest scale.

Under Alternative 2, approximately 76 acres of source habitat would be commercially thinned. Under Alternative 3, approximately 54 acres of source habitat would be treated. Alternative 4 would commercially thin approximately 49 acres of source habitat. These stands would not be considered source habitat after treatment due to reduced canopy closure and loss of stand complexity (multi-strata to single stratum). Under all of the action alternatives, this accounts for less than one-tenth of one percent of the three-toed woodpecker source habitat on the Forest.

Landscape underburning is expected to have minor impacts on source habitat. Low intensity unberburns would not affect stand structure or composition and would have minimal impacts on large downed wood and snags within source habitat stands. Project Design Criteria (see EA Chapter 2) would be implemented that would protect source habitat and other moist and cold upland forest stands from undesired fire impacts.

Cumulative Effects

Past activities, actions, and events in the Kahler analysis area that have impacted three-toed woodpecker source habitat include commercial thinning, regeneration harvest, and overstory removal (18,550 acres since 1975), fire suppression, insect and disease outbreaks, and firewood cutting. Past harvest activities have impacted the quality, quantity, and distribution of three-toed source habitat to a small degree, and impacted dead wood habitat. These activities reduced the amount of late and old structure habitat in the analysis area and fragmented larger late and old structure stands. These activities also reduced potential recruitment of snags by removing green trees. Fire suppression has allowed for the development of multiple canopy layers and dense overstory structure in moist and cold upland forest stands. Insect outbreaks (spruce budworm) have resulted in high mortality of grand fir and Douglas-fir in some stands within the analysis area. These events had variable impacts on habitat quality for the three-toed woodpecker. Past firewood cutting removed potential nesting, roosting habitat adjacent to open roads within the analysis area. These activities have combined to create the existing condition of three-toed woodpecker source habitat in the analysis area.

Present and reasonably foreseeable future activities, actions, and events that affect three-toed source habitat include firewood cutting and hazard tree salvage in the Sunflower Fire area.

Firewood cutting is having similar effects as those described in the past activities section. Hazard trees created by the fire would be felled and removed on approximately 196 acres within the Sunflower Fire within 200 feet of selected roads. This activity would reduce existing and future snag densities (through removal of trees that would succumb to delayed fire mortality), and reduce the acreage of high-density snag habitat in the Wall Watershed. The Wall Watershed is currently (after impacts of the fire were used to update the existing condition) deficient in high density snag habitat in the Eastside Mixed Conifer habitat type. Hazard tree salvage would further reduce ephemeral high-density snag habitat that may be used by the three-toed woodpecker.

When the expected effects of all of Alternatives 2 and 3 combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be a small incremental reduction in source habitat at the analysis area scale. The proposed vegetative treatment activities would generally occur in dry upland forest stands; treatment in these areas would not affect potential three-toed woodpecker habitat quality. Treatment in scattered moist and cold upland forest stands would reduce the quantity, quality, and distribution of three-toed woodpecker source habitat. Since it is very unlikely that the three-toed woodpecker is present in the analysis area due to the preponderance of dry forest habitat and the fragmented/scattered nature of moist and cold upland forest stands, it is not expected that the proposed activities would have an adverse cumulative impact on this species; it is not believed to be present in the analysis area.

Forest Plan Consistency (All Action Alternatives)

Under Alternatives 2 and 3, the overall direct, indirect, and cumulative effects (resulting from commercial harvest and underburning) would result in a small negative habitat trend for the three-toed woodpecker at the Forest scale. Under all of the action alternatives, less than one-tenth of one percent of the three-toed woodpecker source habitat on the Forest would be impacted. This impact would be insignificant at the Forest scale. There would be no impacts on C1 Old Growth stands designated by the Land and Resource Plan (USDA 1990) to provide for the viability of the three-toed woodpecker. The Kahler Project would therefore be consistent with the Forest Plan and the continued viability of the three-toed woodpecker is expected on the Umatilla National Forest.

THREATENED, ENDANGERED, PROPOSED, CANDIDATE, AND SENSITIVE SPECIES

This section of the Wildlife Report constitutes the Terrestrial Wildlife Biological Evaluation for the Kahler Dry Forest Restoration Project. The Endangered Species Act requires federal agencies to use their authorities to carry out programs to conserve endangered and threatened species (ESA Section 5), and to ensure that actions authorized, funded, or carried out by them are not likely to jeopardize the continued existence of listed or proposed species, or result in the destruction or adverse modification of their critical habitats (ESA Section 7). The Forest Service has established direction in Forest Service Manual 2670 to guide the management of habitat for threatened, endangered, and sensitive species. Habitats and activities for threatened and endangered species on National Forest System lands are to be managed to achieve recovery objectives such that special protections under the ESA are no longer necessary (FSM 2670.21). Forest Service Manual 2670.31 defines Forest Service policy for threatened and endangered species as follows:

- Place top priority on conservation and recovery of endangered, threatened, and proposed species and their habitats through relevant National Forest System, state and private forestry, and research activities and programs.
- Establish through the Forest planning process objectives for habitat management and/or recovery of populations, in cooperation with states, the US Fish and Wildlife Service and other federal agencies.
- Review, through the Biological Evaluation process, actions and programs authorized, funded, or carried out by the FS to determine their potential for effect on threatened and endangered species and species proposed for listing.
- Avoid all adverse impacts on threatened and endangered species and their habitat except when it is possible to compensate for adverse impacts through reasonable and prudent measures identified in a biological opinion rendered by the US Fish and Wildlife Service.
- Initiate consultation or conference with the US Fish and Wildlife Service when the Forest Service determines that proposed activities may have an effect on threatened or endangered species, are likely to jeopardize the continued existence of a proposed species, or result in the destruction or adverse modification of critical or proposed critical habitat.
- Identify and prescribe measures to prevent adverse modification or destruction of critical habitat and other habitats essential for the conservation of endangered, threatened, and proposed species.
- Protect individual organisms or populations from harm or harassment as appropriate.

A species list was requested from the US Fish and Wildlife Service on April 2, 2014 for Grant and Wheeler Counties (USDI 2014a) in order to identify which endangered, threatened, de-listed, candidate, and proposed species, if any, may be present in the project area. This species list indicated that there is a potential for the gray wolf (Endangered) to occur in Wheeler and Grant counties. This list also indicated that there is a potential for the greater sage grouse (Candidate) to occur in Wheeler and Grant Counties. Because the sage grouse is not known or suspected to occur on the Umatilla National Forest, and appropriate habitat is not present in the project area, it will not be analyzed further in this document. Review and consideration of the species list provided by the US Fish and Wildlife Service for the Kahler Dry Forest Restoration Project satisfies direction provided in FSM 2671.44 for coordination (consultation) with other federal agencies.

Sensitive species are those identified by the Pacific Northwest (Region 6) Regional Forester as needing special management to meet Forest Service Manual direction, Department regulations, and National Forest Management Act obligations and requirements (USDA 2011). Sensitive Species are those for which population viability is a concern, as evidenced by: 1. Current or predicted downward trends in population numbers or density; or, 2. Current or predicted downward trends in habitat capability that would reduce a species' existing distribution (FSM 2670.5). The Forest Service is required to manage National Forest System lands to maintain viable populations of all native and desired nonnative wildlife, fish, and plant species (including Sensitive Species) in habitats distributed throughout their geographic range on National Forest System lands (FSM 2670.22). Forest Service activities are required to be conducted to avoid actions that may cause a species to become threatened or endangered as a result of Forest Service actions (FSM 2670.12, 2670.22).

Sensitive Species addressed on the Umatilla National Forest include those that have been documented (valid, recorded observation) or are suspected (likely to occur based on available habitat to support breeding pairs/groups) to occur within or adjacent to the Umatilla National Forest boundary. General Forest Service direction for sensitive species is summarized below (FSM 2670.32):

- Assist states in achieving their goals for conservation of endemic species.
- As part of the NEPA process, review programs and activities using a biological evaluation, to determine their potential effect on sensitive species.
- Avoid or minimize impacts to species whose viability has been identified as a concern. If impacts cannot be avoided, analyze the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole.
- Establish management objectives in cooperation with states when projects on National Forest System lands may have a significant effect on sensitive species population numbers or distributions.

Federally listed and sensitive species with a potential to occur on the Umatilla National Forest are found in Table W-32. This determination is based on observation records, vegetative and wildlife species inventory and monitoring, published literature on the distribution and habitat utilization of wildlife species, information provided by the US Fish and Wildlife Service, and the experience and professional judgment of wildlife biologists on the Umatilla National Forest.

Table W-32. Federally ESA listed and Region 6 Sensitive Species with a potential to occur on the Umatilla National Forest.

Species			Occurrence[1]		
Common Name	**Scientific Name**	**Status[2]**	**Umatilla National Forest**	**Kahler Analysis Area**	**Fully Analyzed in this BE**
American peregrine falcon	*Falco peregrinus anatum*	SEN	S	N	
North American wolverine	*Gulo gulo*	SEN	S	H	
Canada lynx	*Lynx canadensis*	THR	D	N	
Columbia spotted frog	*Rana luteiventris*	SEN	D	K	X
Gray wolf[3]	*Canis lupus*	END	D	H	X
Rocky Mountain tailed frog	*Ascaphus montanus*	SEN	D	N	
Lewis' woodpecker	*Melanerpes lewis*	SEN	D	K	X
Bald eagle	*Haliaeetus leucocephalus*	SEN	D	H	X
Painted turtle	*Chrysemys picta*	SEN	S	N	
Townsend's big-eared bat	*Corynorhinus townsendii*	SEN	D	N	
Upland sandpiper	*Bartramia longicauda*	SEN	S	N	
White-headed woodpecker	*Picoides albolarvatus*	SEN	D	H	X
Fir pinwheel	*Radiodiscus*	SEN	D	N	

	abietum				
Johnson's hairstreak	*Callophrys johnsoni*	SEN	D	H	X
Intermountain sulphur	*Colias christina pseudochristina*	SEN	S	H	X
Yuma skipper	*Ochlodes yuma*	SEN	S	N	

[1] S = Suspected, likely to occur based on habitat availability to support breeding pairs/groups within Forest boundary; D = Documented, reliable, recorded observation within the Forest boundary; K = Species known to occur within or near project area; H = Habitat present in project area; N = Habitat not present in project area.

[2] SEN = Sensitive species in USDA Forest Service Region 6; THR = ESA listed as Threatened; END = ESA listed as Endangered; CAN = Candidate for listing under the ESA.

[3] The Northern Rocky Mountain (NRM) Distinct Population Segment of the gray wolf was delisted (removed as endangered from the Endangered Species List), effective May 4, 2009 (USDI 2009b). On August 5, 2010, the Final Order to remove the NRM gray wolf from the Endangered Species List was overturned by a US District Court ruling. Effective May 5, 2011, the US Fish and Wildlife Service reinstated the terms of the 2009 final rule that removed the gray wolf from the Federal Endangered Species List in a portion of the Northern Rocky Mountain Distinct Population Segment. Currently, the gray wolf is considered a Region 6 Sensitive Species on that portion of the Umatilla National Forest east of State Highway 395 and federally listed as Endangered west of State Highway 395. The gray wolf is designated as Endangered in the Kahler Project Area. No Critical Habitat has been proposed or designated in the Northern Rocky Mountains or any portion of Oregon (USDI 1978, USDI 2009a).

SPECIES ELIMINATED FROM FURTHER EFFECTS ANALYSIS

CANADA LYNX

Lynx are medium-sized cats that are strongly associated with boreal forest habitats. Lynx habitat can generally be described as moist boreal forests (generally between 4,100-6,600 feet in elevation) that have cold, snowy winters and a snowshoe hare prey base (Ruggiero et al. 2000, NatureServe 2014). The predominant vegetation of boreal forest is conifer trees, primarily species of spruce (*Picea* spp.) and fir (*Abies* spp.). In mountainous areas, the boreal forests that lynx use are characterized by scattered moist forest types with high hare densities in a matrix of other habitats (e.g., hardwoods, dry forest, non-forest) with low hare densities. These matrix habitats are used for traveling between patches of boreal forest where the majority of foraging occurs. Snowshoe hares comprise the majority of the lynx diet. Lynx prey opportunistically on other small mammals and birds (including red squirrels, other small rodents, grouse, etc.), particularly when snowshoe hare populations are low, as is the case in southern latitudes.

The Canada lynx was listed under the endangered species act as Threatened on March 24, 2000 (65 FR 16052, USDI 2000). The Forest Service and the US Fish and Wildlife Service signed a Canada Lynx Conservation Agreement in 2000. This conservation agreement committed the Forest Service to using the Lynx Conservation Assessment and Strategy (LCAS, Ruediger et al. 2000) in determining effects of actions on the lynx until Forest Plans could be revised to adequately conserve the lynx. The agreement was revised in 2005, and provided for the consideration of the LCAS only in habitats that are currently occupied by lynx. The agreement was further revised on May 12, 2006 (USDI 2006a) to define "occupied habitat" and identify National Forests currently occupied by lynx. This amendment and the Regional Forester's Letter dated June 20, 2006 (USDA 2006) identified the Umatilla National Forest as unoccupied habitat. As unoccupied habitat, the Canada Lynx Conservation Agreement does not apply to the Umatilla National Forest. There is no requirement to manage for lynx in unoccupied habitat. The unoccupied determination was based on a lack of verified lynx observations (National Lynx Survey results, Forest and District databases, etc.) and a lack of evidence of lynx reproduction. While mapped suitable lynx habitat (unoccupied) is present on the Forest, there is no suitable habitat within the Kahler analysis area. There have been no confirmed observations of this species on the District, and the lynx is not currently known to occur on the Forest. Because the Canada lynx was not on the species list provided by the US Fish and Wildlife Service identifying listed species with a potential to occur in Grant and Wheeler Counties, the Umatilla National

Forest is classified as unoccupied lynx habitat (Regional Forester's Letter dated June 20, 2006 (USDA 2006) and Conservation Agreement Amendment dated May 12, 2006 (USDI 2006a)), and there is no suitable habitat in the analysis area, there will be no further analysis of potential impacts on this species.

PAINTED TURTLE

Preferred habitat for the painted turtle includes lakes, ponds, marshes, or low gradient, slow moving streams with a muddy or sandy substrate and aquatic vegetation (NatureServe 2014, St John 2002, Csuti et al. 1997). This species nests in soft soil in openings up to 500 feet from water (NatureServe 2014, St. John 2002, and Csuti et al. 1997). Historically, the District contained few lakes and ponds. Rangeland developments have created ponds for stock-watering purposes in the analysis area. These ponds would not be considered suitable habitat for this species due to the quality of these habitat features; they are generally rock bottom-ponds with little vegetation. In addition, painted turtles have not been observed on the Heppner Ranger District or on the Umatilla National Forest. No further analysis of environmental effects will occur for the painted turtle because suitable habitat does not occur on the Heppner Ranger District and this species has not been observed in or believed to be present in the analysis area.

PEREGRINE FALCON

Suitable habitat for the peregrine falcon includes various open habitats from open grasslands to forested stands in association with suitable nesting cliffs (NatureServe 2014, Marshall et al. 2003). The falcon often nests on ledges or holes on the face of rocky cliffs or crags. Ideal locations include undisturbed areas near water with a wide view and close to plentiful prey. Foraging habitats of woodlands, open grasslands, and bodies of water are generally associated with the nesting territory. Falcons are known to forage over large areas, often ten to fifteen miles from the eyrie. Suitable cliff nesting habitat is not present in the Kahler analysis area. Aerial surveys of potential nest sites were completed on the District in the 1990s. No peregrine falcon eyries were observed. No further analysis of environmental effects on the peregrine falcon will occur due to the fact that the proposed activities would not occur in the vicinity of suitable nesting cliffs and the species is not known to be resident on the District.

TOWNSEND'S BIG-EARED BAT

The Townsend's big-eared bat is widely distributed throughout the western half of the United States. This species primarily uses caves and abandoned mines for day roosting and hibernating (Verts and Carraway 1998). It has also been noted as using buildings for roosting. Research indicates that this species is sensitive to disturbance at roost sites and may abandon roost sites if disturbed. The Townsend's big-eared bat is known to occur in the vicinity of the Keeney Mine on the North Fork John Day Ranger District. There have been no formal surveys for this species on the District. Roost habitat is limited in the Kahler analysis area; there are no abandoned mines (with shafts) and no abandoned buildings that would potentially provide roosting habitat for this species. Because there are no known roost sites and this species is not known or believed to occur in the Kahler analysis area, there will be no further analysis of environmental effects for this species.

UPLAND SANDPIPER

Upland sandpiper habitat is primarily restricted to open tracts of grassland habitat with water or intermittent creeks nearby. This includes large montane meadows and prairie-grasslands (1,000-30,000 acres), usually surrounded with trees (lodgepole pine and some ponderosa pine), or in the middle of sagebrush communities, and generally at elevations from 3,400 to 5,000 feet (Csuti et al. 1997, NatureServe 2014, and Marshall et al. 2003). Taller grassy areas are preferred for nesting and brood cover (NatureServe 2014). Foraging occurs in open meadows (Csuti et al. 1997, NatureServe 2014, and Marshall et al. 2003). Observations of the species have occurred near the town of Ukiah. Large tracts of montane meadows and prairie grasslands are not present in the Kahler analysis area. Because this species is not known to occur in the vicinity of the project area or District and there is no suitable habitat within the analysis area, there will be no further analysis of environmental effects for the upland sandpiper.

YUMA SKIPPER (BUTTERFLY)

The Yuma skipper is found around reed beds in and around freshwater marshes, streams, oases, ponds, seeps, sloughs, springs, and canals (Pyle 2002). Adults are almost always found in close association with the primary larval host plant *Phragmites australis* (giant or common reed). At the National level, this species is ranked N5 (Secure); in Oregon, it is ranked S1? (critically imperiled) (NatureServe 2014). At the species level the Yuma skipper is common in its limited habitat (areas with its host plant) in California, Nevada, Utah, Colorado, northern New Mexico, Arizona, and in isolated areas in Oregon (3 known locations) and Washington. Although all known Oregon locations are situated well off the Forest, and the host plant largely absent from National Forest System lands, this species is suspected to occur on the Umatilla National Forest. Site specific threats are unknown but general threats include loss of wetland habitats to urban or agricultural uses, pesticide spraying in and near wetlands, and grazing damage to wetland habitat. There have been no surveys for this species on the District. Because this species is not known to occur on the District, its primary host plant is not present, and the proposed activities do not constitute an identified threat to the species and its habitat, there will be no further analysis of environmental effects for the Yuma skipper.

FIR PINWHEEL (TERRESTRIAL SNAIL)

This species is found in moist and rocky Douglas-fir forest at mid-elevations in valleys and ravines (NatureServe 2014). This species is often found in or near rock talus or under downed logs. It feeds on detritus and microorganisms on vegetation surfaces. It has been observed at locations in Montana, Idaho, Washington, and Oregon. This species is known from one location on the Umatilla National Forest (Walla Walla Ranger District); the current status of this population is not known. Threats to this species include alteration of appropriate habitat through logging and grazing. Wildfire, road construction, land development, chemical weed control, and drying of sites are also thought to be threats to this species. This species is ranked as Apparently Secure (G4 and N4) at the Global and National scales (NatureServe 2014). At the state level, this species is ranked S1 (critically imperiled) in Oregon (NatureServe 2014). There have been no surveys for this species on the District. Appropriate habitat is not present in the Kahler analysis area. For these reasons, there will be no further analysis of environmental effects for the fir pinwheel.

ROCKY MOUNTAIN TAILED FROG

The tailed frog differs from other frogs found on or adjacent to the Umatilla National Forest by selecting cold, high gradient, boulder and cobble dominated streams for breeding. Streams with dense overstory shade are preferred. Froglets and adults are closely associated with the streams, often hiding in gravel and cobble substrates. Tadpoles cling to boulders and cobbles; full development of this species requires as many as 8 years to complete (NatureServe 2014). NatureServe ranks this species as apparently secure (G4) globally, and imperiled (S2) at the scale of the state of Oregon (NatureServe 2014).

The distribution of this species in Oregon is relatively restricted to the northeast corner of the state. Observations have been recorded in Wallowa, Union, Baker, and Umatilla Counties. There are no observation records for this species in the analysis area. There are no perennial streams in the Kahler analysis area that would be used by this species for breeding, foraging, and rearing habitat based on geomorphology, gradient, and stream temperature. This species is not known to or suspected to occur in the analysis area. For this reason, there will be no further analysis of effects for the Rocky Mountain tailed frog.

NORTH AMERICAN WOLVERINE

The wolverine inhabits high elevation, alpine and subalpine conifer forest types, with limited exposure to human interference (Ruggiero et al. 1994, Wolverine Foundation (TWF) 2012). Natal denning habitat includes open rocky slopes (talus or boulders) surrounded or adjacent to high elevation forested habitat and forested and semi-forested subalpine and alpine vegetation. Snow cover appears to be critical to denning habitat selection; wolverine select areas that maintain a snow depth greater than 3 feet into April and May for denning (Aubrey et al. 2007, Parks 2009, Ruggiero et al. 1994, TWF 2012). Research has found that wolverine spend a large proportion of their time, regardless of the season, in areas that provide suitable natal denning habitat (Parks 2009). This species has a National Heritage Rank of critically imperiled (S1) in Oregon and vulnerable to extirpation or extinction (N3) at the National level (NatureServe 2014). Wolverine populations appear to be small, low density, and relatively isolated even in ideal habitat (Aubry et al. 2007, NatureServe 2014). The wolverine is an opportunistic scavenger, with large mammal carrion the primary food source year-round. While foraging, they generally avoid large open areas and tend to stay within forested habitat at mid and high elevations (>4,000') and typically travel 18-24 miles to forage (Ruggiero et al. 1994, TWF 2012).

This species is currently a Region 6 Sensitive Species. A Proposed Rule to list the Distinct Population Segment of the North American wolverine in the contiguous United States as Threatened under the Endangered Species Act was released on February 4, 2013 (USDI 2013b). On August 13, 2014, the USFWS withdrew its proposal to list the wolverine under the Endangered Species Act (ESA). As a result of this action, the wolverine returned to the Region 6 Sensitive Species list effective September 13, 2014. The wolverine was not on the preliminary species list provided by the US Fish and Wildlife Service identifying ESA listed, candidate, and proposed species with a potential to occur in the Kahler area. Snow tracking surveys conducted on the District during the early 1990s and 2011 for wolverine, fisher, American marten, and lynx have resulted in no suspected wolverine tracks. Confirmed observations of wolverine have occurred in the last several decades in lower elevation areas of Oregon. These records are believed to be extreme dispersal events from core populations, and are not representative of self-sustaining populations (Aubry et al. 2007, Verts and Carraway 1998).

No potential natal denning habitat is present in or near the analysis area. Contiguous subalpine forest types, backcountry (wilderness, Inventoried Roadless, Scenic Areas, and potential wilderness) habitat, open rocky slopes at high elevations, and sufficient snow cover for natal denning do not occur in the Kahler project area. Potential foraging habitat is present in the analysis area. These stands are relatively small and disconnected from one another due to past activities and the broken nature (timbered draws and open ridges) of the analysis area. For these reasons, habitat quality is considered poor. The wolverine is not currently known to occur in the Kahler analysis area; there have been no sightings of this species in the area. Based on the quality and quantity of potential poor quality foraging habitat, the transportation system in the Kahler area, and the distance from suitable subalpine and backcountry habitats, it is very unlikely that wolverine would pass through the Kahler area. Because the wolverine was not on the preliminary species list provided by the US Fish and Wildlife Service identifying ESA listed, candidate, and proposed species, is not known to occur in the area, there is no potential natal denning habitat, no low disturbance higher-elevation backcountry habitat, and limited low quality foraging habitat is present in the analysis area, there will be no further analysis of effects for the North American wolverine.

SPECIES ANALYZED IN DETAIL

BALD EAGLE

Preferred habitat for the bald eagle occurs near large bodies of water (rivers, lakes, etc.) that support an adequate food supply (NatureServe 2014 and USDI 1986). In the Pacific Northwest recovery area, preferred nesting habitat for bald eagles is predominately uneven-aged, mature, coniferous stands (ponderosa pine and Douglas-fir) or large black-cottonwood trees along riparian corridors (NatureServe 2014 and USDI 1986). Eagles usually nest in mature conifers with gnarled limbs that provide ideal platforms for nests. The nest tree is characteristically one of the largest in the stand and usually provides an unobstructed view of a body of water (USDI 1986). In Oregon, the majority of nests are within 0.5 miles of the shoreline (Anthony and Isaacs 1981). Important prey species include fish, birds, mammals, and carrion. (NatureServe 2014 and USDI 1986). This species was removed from the Federal List of Endangered and Threatened Wildlife by the US Fish and Wildlife Service on August 8, 2007 (USDI 2007a). The northern bald eagle population is currently secure (NatureServe 2014).

Bald eagle nesting habitat is not present in the Kahler analysis area. The streams within the allotment do not have adequate fish populations to support a nesting pair of eagles and their young through the summer. The nearest bald eagle nest is located approximately .75 miles east of the Kahler project area. A Management Plan was prepared for this nest (Dry Creek) in 1999 (VanWinkle 1999). This plan was designed to meet or exceed the guidelines for bald eagle management in the Recovery Plan for the Pacific Bald Eagle (USDI 1986). It also meets the requirements of the Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act, and Endangered Species Act. The Plan identifies a Bald Eagle Consideration Area (BECA) for the nest.

The BECA encompasses the home range of a nesting pair of eagles, including the nest site, feeding areas, and perching/roosting areas. The designation of an area within the BECA does not restrict human activity within the BECA boundary; management recommendations are provided to assess and mitigate for potential impacts to eagles. At a smaller scale, the Bald Eagle Management Area (BEMA) includes the nest tree, roost tree(s), and other perches. All activities in the BEMA are subordinate to the needs of the eagle. A portion of the Kahler analysis area lies within the Bald Eagle Management Area and Bald Eagle Consideration Area for this nest.

Management recommendations (Van Winkle 1999) applicable to the Kahler Project include:

- Evaluate all present and future projects proposed on public lands within the BECA for potential impacts to the nesting pair;
- Enforce seasonal restrictions within the BECA to avoid disturbance to nesting or roosting eagles;
- Maintain or improve fish and wildlife habitat to enhance foraging opportunities for eagles.

The Recovery Plan for the Pacific Bald Eagle (USDI 1986) and the National Bald Eagle Management Guidelines (USDI 2007b) also identify tasks that would contribute to the recovery of the bald eagle.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

In the short term, there would be no change in existing bald eagle habitat quality in the vicinity of the Dry Creek nest. In the mid and long term, dry upland forest stands would continue to become denser, and would become more susceptible to mixed severity fire. While it is expected that mixed severity fire would occur, there would be larger patches of high severity impacts (due to higher flame lengths and resulting passive crown fire) than would have been expected historically. If this were to occur, potential roosts (large diameter green trees and snags) in the vicinity of the nest could be lost as a result of fire impacts. Due to the structure and composition of the nest stand, it is possible that high severity effects could occur in this area.

Common to All Action Alternatives

Direct and Indirect Effects

The effects of Alternatives 2, 3, and 4 would be the same. All proposed treatment activities would occur at least 0.75 miles from the nest; as a result, there would be no effect on nesting eagles or the nest site. Activities in the Kahler area would largely not be visible from the nest location. Prescribed fire (ground operations and potentially air operations) would be managed such that there would be no impacts at the nest site. Aircraft would not disturb the nest or nesting activities because all use would be > 1,000 feet from the nest. In addition, all proposed helicopter harvest units are located outside of the Bald Eagle Consideration Area. The Kahler project would retain all old trees and trees with old growth characteristics that are desirable to eagles for roosting and/or perching. The Kahler project would also retain all snags >10 inches in diameter, except for those that are a hazard to operations. It is expected that a small number of snags that pose a hazard within treatment units; at the analysis area scale (for snags), it is likely that these impacts to large snags would not be measureable and would not impact the suitability of the area for bald eagles. Activities proposed under the Kahler project would restore dry upland forest stands potentially used by the nesting pair for foraging, moving them toward a more characteristic composition and structure and providing habitat for prey more similar to what occurred there historically. The activities proposed under the Kahler Project would be consistent with the Dry Creek Bald Eagle Nest Management Plan and the National Bald Eagle Management Guidelines (USDI 2007b). The activities proposed under the Kahler Project would not agitate or bother roosting or foraging bald eagles to the degree that causes injury or substantially interferes with breeding, feeding, or sheltering behavior. These activities would not result in a loss of productivity or nest abandonment. These activities would therefore also be consistent with the Bald and Golden Eagle Protection Act. No known communal roosts are known to occur in the area, so there would be no impacts to these features.

Cumulative Effects

Past, present, and future activities that have affected bald eagle habitat in the analysis area include past timber harvest. These activities resulted in the removal of potential roost trees within the analysis area; in some areas, large trees continue to be lacking. The effects of these activities have been incorporated into the existing condition for this species. The activities proposed under the Kahler Project (Alternatives 2, 3, and 4) have the potential to impact potential roost snags as well. The proposed activities would not have an adverse cumulative impact on the bald eagle due to the fact that only a portion of the large (≥21 inch dbh) Douglas-fir and grand fir may be affected within treated stands. Large diameter ponderosa pine, old Douglas-fir, old grand fir, and large snags that do not pose a hazard/danger to operations would be retained in proposed units, in addition to large potential roost trees available in untreated stands and skips within treatment units.

Determination and Rationale (All Action Alternatives)

Alternatives 2, 3, and 4 may impact the bald eagle, but are not likely to contribute to a trend towards federal listing or cause a loss of viability to the population or species. The rationale for this determination is as follows:

- A small number of potential roost snags (large diameter snags that pose a hazard/danger) may be affected by the proposed treatment activities. This impact would not be measureable at the scale of the snag analysis area, and is not expected to impact the availability of potential roost trees in those stands nearest the nest.
- The Kahler project would retain large, old, complex tress and promote the development of these trees in the future.
- All proposed activities would be consistent with the Dry Creek Bald Eagle Nest Management Plan, the National Bald Eagle Management Guidelines (USDI 2007b) and Bald and Golden Eagle Protection Act.

COLUMBIA SPOTTED FROG - SENSITIVE

AFFECTED ENVIRONMENT

Columbia spotted frogs are highly aquatic and rarely found far from permanent water, but they can also utilize intermittent streams and meadows in the spring. They occupy the sunny, vegetated margins of streams, lakes, ponds, spring complexes, and marshes. Columbia spotted frogs are mobile; they seasonally move between hibernacula (overwintering sites), breeding habitat, and wet meadow/riparian foraging areas (Bull and Hayes 2002). Some Columbia spotted frogs will remain and overwinter in breeding habitat if conditions are ideal. Hibernacula are typically ponds, slow-moving streams, and springs where water surrounding the frog does not freeze and oxygen levels are adequate (Tait 2007, Bull and Hayes 2002). Breeding occurs in shallow (<60 cm) emergent wetlands such as riverine side channels, beaver ponds, springheads, and the wetland fringes of ponds, small lakes, and livestock ponds. Water levels must persist until eggs are hatched and tadpoles transform. Adults exhibit strong fidelity to breeding sites, with egg deposition typically occurring in the same areas in successive years. Foraging takes place in all types of permanent or ephemeral wetland habitats, including meadows, stream margins, ponds, ditches, and intermittent habitats; these areas constitute movement corridors between breeding and hibernation sites. Because frogs are especially vulnerable to predation during summer foraging, some level of overhead plant cover is optimal. NatureServe ranks the Columbia spotted frog as apparently secure (N4) at the National and Global scale and imperiled/vulnerable (S2/S3) at the state (Oregon) level (NatureServe 2014). The Great Basin subpopulation is ranked as imperiled (T2) due to a high risk of extinction due to very restricted range, very few populations, steep population declines, and other factors. Columbia spotted frogs in northeast Oregon are more closely-affiliated with the Northern Distinct Population Segment (DPS) of the species than they are with the Great Basin DPS (Tait 2007).

This species has been observed in the vicinity of the analysis area. Surveys in 2006 identified breeding locations in the vicinity of Bull Prairie Reservoir and upper Porter Creek. It is assumed to be present in the analysis area due to the fact that suitable ponds (potential breeding and overwintering habitat) are present. Summer foraging habitat is also assumed present in some locations associated with perennial streams.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

In the short term, the quality and extent of Columbia spotted frog habitat would not change. In the mid and long term, continued recovery of riparian habitat would improve habitat quality for this species. Riparian areas would continue to recover from past disturbances, resulting in increased riparian shading (overstory and shrubs) along stream channels and pond edges. In the long term, the risk of high severity wildfire would also increase due to continued multi-strata development and increasing fuel loads. While it is expected that mixed severity fire would occur, there would be larger patches of high severity impacts (due to higher flame lengths and resulting passive crown fire) than would have been expected historically. High severity impacts could occur in dense riparian habitat along perennial streams that may be used by this species. Mixed severity fire would not alter the suitability of potential breeding habitat (ponds) in the analysis area. These habitats are generally in openings where fire effects would be minimal.

Common to All Action Alternatives

Direct and Indirect Effects

Under all of the action alternatives, there would be no commercial thinning or other mechanical treatment activities within Class I, II, or III Riparian Habitat Conservation Areas (RHCAs) potentially used by this species for summer foraging, breeding, or overwintering. Under Alternatives 2 and 3, commercial and non-commercial thinning is proposed in Class IV RHCAs (intermittent, non-fish bearing channels). Machinery would be allowed to winch or skid hand-felled trees out of Class IV riparian areas, but would not be allowed to enter them. Because these channels only flow during spring high flows and do not provide potential foraging, breeding, or overwintering habitat for this species, there would be no impacts on the spotted frog through implementation of these activities in these areas. Due to the fact that Columbia spotted frogs rarely venture far from perennial water, vegetative treatment activities proposed outside of RHCAs would have no impacts on this species or its habitat. All potential breeding sites (ponds) and springs would be buffered from treatment activities a distance of 100 feet (see Project Design Criteria). Buffering these sites would eliminate potential impacts to this species. Hand thinning of conifers (small diameter) in aspen stands associated with Class I, II, and III channels would not directly or indirectly impact this species.

While spotted frogs are assumed to be present in the analysis area, potential habitat is largely restricted to man-made ponds. Other activities proposed under all of the action alternatives, including burning, maintenance and clearing of closed system roads, and temporary road construction (Alternatives 2 and 3 only), would also have no impacts on this species. Habitat quality of ponds would not be impacted due to the fact that proposed underburning would be low intensity, and the vegetation immediately adjacent to potential pond habitat would not be affected by burning. These areas would generally be too moist for fire to carry. Pumping of water from pond sites during underburning or activity fuels treatment activities would also not impact this species. Appropriately-sized screens would be utilized on all pumps; tadpoles would not be sucked through pumps or impinged on intake pipes. The amount of water expected to be used from ponds would be negligible.

Cumulative Effects

Past activities that affected potential spotted frog habitat include timber harvest, cattle grazing, aspen restoration, and gravel pit/pond construction. Portions of two grazing allotments are included in the analysis area. Past cattle grazing affected potential habitat by altering the structure and composition of riparian communities. Grazing likely directly impacted spotted frogs at breeding and foraging sites (man-made ponds). Grazed habitats are currently recovering from past overgrazing. Past cattle grazing also created potential breeding habitat through the construction of water sources (ponds) where they previously did not exist. Rock pit ponds created through road construction also increased available habitat for the spotted frog in upland areas. Aspen restoration activities (fencing, planting, etc.) have improved riparian habitat condition by allowing shrub and tree regeneration. Past timber harvest affected riparian areas through the removal of streamside vegetation and disturbance of riparian communities. These activities increased the vulnerability of this species to predation by removing cover and altered suitable habitat (slow moving streams, wet meadows, springs, etc.). These past activities have combined to create the existing condition of spotted frog habitat in the analysis area.

Ongoing activities with the potential to affect the spotted frog include livestock grazing and aspen restoration. Current cattle grazing is occurring at relatively low stocking levels within the analysis area, when compared to historical grazing. Cattle grazing is not adversely affecting potential spotted frog habitat in the analysis area. Direct impacts to spotted frogs are considered negligible. Aspen restoration activities are having the same impacts as those described previously.

Reasonably foreseeable future activities with a potential to affect this species include cattle grazing, aspen restoration, and maintenance of water sources. Future cattle grazing and aspen treatments are expected to have the same effects as those described above. Maintenance of water sources has the potential to affect breeding sites and cause mortality of developing tadpoles and froglets. These effects would not persist beyond the year in which pond cleaning occurs.

When the expected effects of these alternatives are combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be no incremental reduction in suitable breeding, overwintering, or foraging habitat. No mechanical treatment activities would occur in suitable riparian habitat. Burning would also not be expected to impact potential breeding sites due to the timing and oversight of proposed burns. Prescribed fire managers would implement fire to meet the written objectives for a low intensity underburn; moderate and high severity impacts to suitable spotted frog habitat would be very unlikely.

Determination and Rationale (All Action Alternatives)

Under all of the action alternatives, there would be no impact on the Columbia spotted frog. The rationale for this determination is as follows:

- Commercial thinning and mechanical activity fuels treatment (if this activity occurs) would not occur within suitable habitat (those with perennial streams) in RHCAs. RHCA treatments proposed under Alternatives 2 and 3 would occur along intermittent stream channels that do not provide breeding, summer foraging, or overwintering habitat.

- Potential breeding and overwintering habitat in ponds and springs would not be affected by the proposed activities. These sites would be buffered from treatment activities (see Project Design Criteria, EA Chapter 2).
- Pumping of water from ponds potentially used for breeding would not impact individuals; screens would eliminate the possibility of direct mortality of developing tadpoles and froglets.
- Burning would not directly impact this species or impact the quality of potential breeding habitat within the project area.
- There would be no cumulative impacts on suitable breeding, overwintering, or foraging habitat under the proposed action alternatives.

WHITE-HEADED WOODPECKER

AFFECTED ENVIRONMENT

The white-headed woodpecker utilizes mature, single-stratum ponderosa pine-dominated habitats for nesting and foraging (NatureServe 2014). This species has also been found to utilize post-fire stands (mixed severity and mosaic burns) for foraging and nesting (Wightman et al. 2010). While white-headed woodpeckers use relatively open landscapes, a mosaic of open habitat for nesting in close proximity to closed-canopy forests which provide foraging habitat is important for this species. (Mellen-McLean et al. 2013, Hollenbeck et al. 2011). This species relies heavily upon the seeds from large ponderosa pine cones for its foraging needs. This species will also utilize insects that are gleaned from ponderosa pine trees. Large ponderosa pine snags are utilized for nesting purposes. Interior Columbia Basin Ecosystem Management Project (Wisdom et al. 2000) indicates that basin-wide, >50% of watersheds have strong negative declines in the availability of source habitats (old growth ponderosa pine, aspen/cottonwood/willow, large diameter ponderosa pine snags) for this species. The White-headed Woodpecker Conservation Strategy (Mellen-McLean et al. 2013) recommends that the following management activities or actions be taken to restore white-headed woodpecker habitat:

- Retain, protect, and grow more large, older ponderosa pine trees used for foraging;
- Retain, protect, and grow large snags used for nesting;
- reduce shrub cover and excess down wood to reduce numbers of small mammal which prey on nests;
- reduce canopy density across the landscape to provide interspersion of open and closed pine/dry forest stands;
- retain and create spatial heterogeneity within stands;
- reintroduction of rust-resistant white pine or sugar pine where appropriate would provide an alternative winter food source (not applicable to the Kahler planning area).

The white-headed woodpecker is known to occur in the analysis area. A pair of white-headed woodpeckers was observed in proposed Unit 10 during reconnaissance in the summer of 2013 in a dense mixed conifer stand. While there have been anecdotal sightings of white-headed woodpecker in the vicinity of the Wheeler Point Fire Area (high severity burned stands and burned stands with relatively intact overstories along the 25 Road), none have been documented in the database of record. Due to fire suppression in dry upland forest habitats, many areas that historically supported open stands of large diameter ponderosa pine now support mixed ponderosa pine, Douglas-fir, grand fir, and larch stands. The Silviculture Report indicates that there are currently 1,550 acres of old forest single-stratum habitat in the analysis area. This structural type is generally believed to be synonymous with suitable white-headed woodpecker habitat, although dense stands are used as well.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

In the short term, there would be no change in existing habitat for this species. In the mid and long term, shade tolerant tree species would continue to encroach into historically open ponderosa pine habitats. The composition of these stands would change; a higher proportion of shade tolerant tree species would be present in these stands. Invading tree species would compete with ponderosa pine for resources. Ultimately, large diameter ponderosa pine trees and snags would be less common, reducing habitat quality for the white-headed woodpecker. As forested stands became denser and more widespread, the risk of high severity wildfire impacts would also increase. While it is expected that mixed severity fire would occur, there would be larger patches of high severity impacts (due to higher flame lengths and resulting passive crown fire) than would have been expected historically. While habitat quality in burned stands would initially improve in the short and perhaps mid-term, ultimately, there would be a reduction in large diameter green trees over more acres and in larger patches than would be expected under historic conditions. Low and moderate severity patches would improve habitat for white-headed woodpecker, as smaller encroaching trees would be thinned and snags created for potential nesting and foraging.

Common to All Action Alternatives

Direct and Indirect Effects

Generally, the effects associated with each of the action alternatives on the white-headed woodpecker and its habitat would be the same; only the extent, or the number of acres treated, would vary between alternatives. Existing suitable habitat (old forest single-stratum stands in dry upland forest dominated by ponderosa pine) would be treated under all of the action alternatives. This treatment would require a Forest Plan amendment to implement, as it would be inconsistent with the Forest Plan. These activities would be consistent with Regional direction regarding old forest management. This activity has the potential to remove structures and features desired by white-headed woodpeckers, including large diameter snags (through hazard/danger tree felling), medium sized seed-producing ponderosa pine, and existing "clumpiness" and heterogeneity. Harvest prescriptions/design features would reduce the potential for these impacts to occur. The quality of capable white-headed woodpecker habitat would be improved in the short and long term through commercial thinning (with skips and gaps) in dry upland forest habitat. Variable density thinning would retain or promote heterogeneity (interspersion of clumps of varying size, single trees, untreated skips, and small openings) within treated stands, improving habitat quality for this species. Snags >10 inches dbh would be retained to the greatest extent possible in treatment units; only those that pose a hazard would be felled. Danger tree felling along roads used to access units would also affect snags to some degree. Because the impact on snag densities and distribution are expected to be minor at the scale of the analysis area (see MIS:Primary Cavity Excavator section), impacts associated with loss of nesting structure would be minor under all of the action alternatives. This activity is not expected to measurably impact this species or the availability of potential nesting snags in the Kahler project area or the larger snag analysis area. Tree species uncharacteristic of old forest single-stratum ponderosa pine habitats would be targeted for removal. Old (>150 years old) ponderosa pine and Douglas-fir would be favored for retention. Reduced stand densities would improve stand health and stimulate growth in residual trees. Skips within commercial thinning units would provide for endemic or greater insect and disease activity that will provide white-headed woodpecker forage in years with poor ponderosa pine seed production.

Non-commercial thinning would not impact habitat quality for this species, as snags and overstory trees would not be impacted by this activity.

Because burning would occur over approximately 31,000 acres under all of the action alternatives, the effects of burning under these alternatives would be virtually the same. Burning has the potential to reduce potential nesting sites through the consumption of snags. Research indicates that burning (with no prior treatment and with prior thinning) in similar habitats resulted in a loss of snags on affected acres (Hessburg et al. 2010, Harrod et al. 2009). These studies found that the vast majority of snags lost to burning were small diameter (<10" dbh); impacts to large snags were relatively minor (Hessburg et al. 2010, Harrod et al. 2009). Thies and others (2008) found that up to 5% of large trees and up to 14% of all trees in pine stands that were prescribed burned were killed immediately or died in the 3 years following burning. Burning is also expected to create snags; losses of existing snags would be offset or exceeded by new snag creation (Hessburg et al. 2010, Harrod et al. 2009). Burning in the Kahler analysis area is expected to have similar impacts as those described above due to the similar habitat conditions and the proposed intensity, timing, and mosaic nature of underburns.

New temporary road construction would occur under Alternatives 2 and 3; new system road construction would occur under all of the action alternatives. Temporary and new system roads would follow existing skid trails or utilize existing openings where possible. Impacts to overstory vegetation and snags would therefore be minimal, and generally associated with hazard tree abatement. This activity would not alter habitat suitability for this species.

Cumulative Effects

Past activities, actions, and events that affect the white-headed woodpecker and its habitat within the analysis area include timber harvest, fire suppression, and post-fire salvage. Past timber harvest targeted large diameter open-grown (single-strata) ponderosa pine that this species is dependent on for foraging, reducing the quality and quantity of suitable habitat for this species. Harvest also impacted large diameter ponderosa pine snags used for nesting. Fire suppression has allowed for the encroachment of fire-intolerant conifer species into historically open ponderosa pine stands. The composition and structure of these stands has changed, reducing the quality of these stands for the white-headed woodpecker. Fire salvage in the Wheeler Point Fire area also impacted potential nesting and foraging habitat in the high severity portion of the fire. Research indicates that species utilizes post-fire stands where available. Salvaged stands are generally unsuitable for this species due to the level of snag removal. These activities, actions, and events have combined to create the existing condition of white-headed woodpecker habitat in the analysis area.

Ongoing (present) and reasonably foreseeable future activities in the analysis area that affect the white-headed woodpecker or its habitat include fire suppression. This activity is having the same effects as those described previously.

When the effects of these alternatives are combined with the residual and expected effects of past, present, and future activities in the analysis area, there would be an incremental improvement in habitat for the white-headed woodpecker in the mid and long term resulting from old forest ponderosa pine restoration treatments within commercial harvest units. The proposed activities under Alternatives 2, 3, and 4 would have a beneficial effect on white-headed woodpecker habitat in the short and long term. Capable habitat would be moved into a suitable habitat condition by all of the action alternatives; the magnitude (number of acres) would vary by alternative. While there would be a short term reduction in snags due to hazard and danger tree felling, the impact is expected to be minor. By moving these stands toward a condition more characteristic of historical conditions and improving stand health, the proposed vegetative treatment activities may reduce long term snag recruitment to an unknown degree. It is possible that Forest Plan standards for snag density would not be met in treated stands for some period of time following treatment. When combined with past activities, it is not expected that there would be an adverse cumulative impact on this species due to reductions in large snags due to the fact that existing snags would largely be retained in treatment units, and snag recruitment in post-treatment stands would be expected to be similar to that which occurred historically in dry forest stands.

Alternative 2

Direct and Indirect Effects

This alternative would have similar impacts as those described in the *Common to All Action Alternatives* section. Approximately 380 acres would be moved into a single-stratum late and old structure condition in the short term, for a total of 1,830 acres of old forest single-stratum structure stands after treatment. In the long term (year 2065 – see Silviculture Report), it is projected that there would be 10,510 acres of old forest single-stratum structure stands in the analysis area. Much of this would be the result of thinning that moves younger stands into an intermediate structure and density, the application of prescribed burning on a regular basis (10-20 year interval), and growth over time. Because this alternative would move the most acres into or toward an OFSS condition in the short and long term, it would have the greatest short and long term impact on the availability and distribution of suitable white-headed woodpecker habitat in the analysis area. In the short term, 7% of the analysis area would be comprised of OFSS habitat. In the long term (year 2065), it is projected that 39% of the analysis area would be comprised of OFSS habitat. The lower limit of the HRV range for this structure is 40%. While still below HRV, this structural stage is projected to be available at similar levels as those that would be expected historically.

The White-headed Woodpecker Conservation Strategy (Mellen-McLean et al. 2013) recommends maintaining one-third of the dry forest landscape in denser patches for white-headed woodpecker habitat. In the short term, this alternative would retain approximately 25% of the dry forest landscape in a moderate and high density condition (See Silviculture Report). These patches would generally be present in RHCAs, Dedicated Old Growth stands, and moist and cold stands that were dropped during project development. While this is less than the recommended one-third of the dry forest ground recommended by Mellen-McLean and others (2013), there will also be approximately 10 to 15% of proposed units that will not be treated and that will provide moderate and high density dry upland forest habitat that is not accounted for. The remainder of the recommendations made in the Conservation Strategy would be addressed to some extent by the treatment activities proposed in the Kahler area.

Cumulative Effects

This alternative would have the greatest positive incremental effect on habitat for the white-headed woodpecker. It would do the most to reverse past habitat changes resulting from fire suppression and past harvest. Conversely, this alternative would also have the greatest expected impact on snag habitat, as it would thin the most acres and use the most miles of road to access treatment units. While snag habitat would likely be reduced, it is not expected that there would be an adverse impact on this species given design measures to reduce impacts to snags.

Alternative 3

Direct and Indirect Effects

Approximately 380 acres would be moved into a single-stratum late and old structure condition in the short term, for a total of 1,830 acres of old forest single-stratum structure stands after treatment. This would be the same number of acres and proportion of the analysis area as was described under Alternative 2. In the long term (year 2065 – see Silviculture Report), it is projected that there would be 9,970 acres of old forest single-stratum structure stands in the analysis area. This would be the result of dropping larger patches of moderate and high density habitat across the landscape to retain habitat for density dry forest-associated species, white-headed woodpecker, and Rocky Mountain elk. Alternative 3 would move approximately 540 fewer acres into an OFSS condition in the long term when compared to Alternative 2. In the long term (year 2065), it is projected that 37% of the analysis area would be comprised of OFSS habitat. The lower limit of the HRV range for this structure is 40%. While still below HRV, this structural stage is projected to be available at similar levels as those that would be expected historically, but at a slightly lesser proportion that Alternative 2.

Because this alternative would treat fewer acres of old forest (120 fewer acres existing OFSS) and require less road use (closed, seasonal, and existing/new temporary roads), the potential impacts on existing and future snags (through hazard and danger tree felling and reduced snag recruitment) would be less than Alternative 2.

In the short term, this alternative would retain approximately 27% of the dry forest landscape in a moderate and high density (See Silviculture Report). These patches would generally be present in RHCAs, Dedicated Old Growth stands, moist and cold stands that were dropped during project development, and in dense dry forest patches dropped specifically to address the availability and distribution of larger patches of dense dry forest habitat across the landscape following implementation. While this is less than the recommended one-third of the dry forest ground recommended by Mellen-McLean and others (2013), there will also be approximately 10 to 15% of proposed units that will not be treated and that will provide moderate and high density dry upland forest habitat that is not accounted for. The remainder of the recommendations made in the Conservation Strategy would be addressed to some extent by the treatment activities proposed in the Kahler area.

Cumulative Effects

This alternative would have a positive incremental effect on habitat for the white-headed woodpecker. It would improve habitat on slightly fewer acres than Alternative 2. The impact on existing and future snags would be less under this alternative than under Alternative 2 due to fewer acres of commercial harvest; this cumulative reduction is not expected to adversely impact this species.

Alternative 4

Direct and Indirect Effects

Approximately 380 acres would be moved into a single-stratum late and old structure condition in the short term, for a total of 1,830 acres of old forest single-stratum structure stands after treatment. This would be the same as described under Alternatives 2 and 3. In the long term (year 2065 – see Silviculture Report), it is projected that there would be 8,880 acres of old forest single-stratum structure stands in the analysis area. Alternative 4 would move approximately 1,600 and 900 fewer acres into an OFSS condition in the long term when compared to Alternatives 2 and 3, respectively. This would be the result of dropping larger patches of moderate and high density habitat, Class IV RHCAs, and areas inaccessible from the existing road system (including existing temporary roads) to retain habitat for density dry forest-associated species, white-headed woodpecker, and Rocky Mountain elk. In the long term (year 2065), it is projected that 33% of the analysis area would be comprised of OFSS habitat. The lower limit of the HRV range for this structure is 40%. While still below HRV, this structural stage is projected to be available at similar levels as those that would be expected historically, but at a slightly lesser proportion that Alternatives 2 and 3.

Because this alternative would treat fewer acres and require less road use (closed, seasonal, existing temporary roads, an no new temporary road construction) than the other action alternatives, the potential impacts on existing and future snags (through hazard and danger tree felling and reduced snag recruitment) would be less than Alternative 2.

In the short term, this alternative would retain approximately 28% of the dry forest landscape in a moderate and high density (See Silviculture Report). These patches would generally be present in RHCAs (all classes), Dedicated Old Growth stands, moist and cold stands that were dropped during project development, areas inaccessible from the existing road system (no new temporary road construction under this alternative), and in dense dry forest patches dropped specifically to address the availability and distribution of larger patches of dense dry forest habitat across the landscape following implementation. While this is less than the recommended one-third of the dry forest ground recommended by Mellen-McLean and others (2013), there will also be approximately 10 to 15% of proposed units that will not be treated and that will provide moderate and high density dry upland forest habitat that is not accounted for. The remainder of the recommendations made in the Conservation Strategy would be addressed to some extent by the treatment activities proposed in the Kahler area.

Cumulative Effects

This alternative would have a positive incremental effect on habitat for the white-headed woodpecker. It would improve habitat on slightly fewer acres than Alternatives 2 and 3. The impact on existing and future snags would be less under this alternative than under Alternatives 2 and 3 due to fewer acres of commercial harvest; this cumulative reduction is not expected to adversely impact this species. It would also provide more acres in moderate and high density conditions for white-headed woodpecker foraging.

Determination and Rationale (Alternatives 2, 3, and 4)

Alternatives 2, 3, and 4 may impact individuals or habitat, but are not likely to contribute to a trend towards federal listing or cause a loss of viability to the population or species. The rationale for this determination is as follows:

- The white-headed woodpecker is known to occur in the analysis area.
- Treatment would occur in existing suitable habitat (old forest single stratum stands) for this species. There is a potential that treatment in these stands could impact habitat features (clumps and younger trees used for gleaning) and structure (i.e. large snags) desired by this species to some extent.
- Variable density thinning (with skips and gaps) would move stands into suitable habitat conditions in the short and long term. Treatment activities and haul may impact some large diameter ponderosa pine and Douglas-fir snags that are a hazard/danger to operations. Otherwise, snags >10 inches dbh would be retained where they occur. It is not expected that this activity would measurably impact large snag densities at the analysis area scale.
- Future snag recruitment may be impacted through a reduction in density-dependent mortality. As treated stands would be moved into a more appropriate dry forest structure and composition (moving toward the HRV), and impacts to existing snags are expected to be minor, this long term impact to snags is not expected to adversely impact this species or potential habitat. Snag recruitment in post-treatment stands would be expected to be similar to that which occurred historically.
- Burning has the potential to impact large diameter snags potentially used for nesting. This activity is expected to have minor impacts on snag habitat due to the timing, intensity, and mosaic nature of burning, and research findings in similar habitat.
- All of the action alternatives would largely address the recommendations made in the Conservation Strategy (Mellen-McLean et al. 2013). Alternative 4 would provide a higher proportion of the dry forest landscape with high and moderate density than the other two action alternatives. The skips provided in treated stands would aid in providing heterogeneity at the stand scale and contribute somewhat to landscape scale heterogeneity desired by this species.

LEWIS' WOODPECKER

AFFECTED ENVIRONMENT

The Lewis' woodpecker is typically associated with open ponderosa pine woodland habitat near water. They have also been associated with stand replacement fires (5 to 10 years post-fire). Lower elevation ponderosa pine stands are generally considered suitable habitat for this species. This species will also utilize post-fire habitats that have a high proportion of ponderosa pine and Douglas-fir. The Lewis' woodpecker is an aerial insectivore that uses dominant snags in burned and unburned areas for perching. This species utilizes large diameter dead and dying trees (generally cottonwood and ponderosa pine), typically near streams, for nesting. This species typically nests in pre-existing cavities, but will also excavate cavities. Although this species typically nests in ponderosa pine snags, it has been found to nest in other species, including white fir and lodgepole pine (Raphael and White 1984).

The Interior Columbia Basin Ecosystem Management Project (Wisdom et al. 2000) indicates 85% of the watersheds throughout the basin show a strong negative trend in source habitats (old forest single-stratum structural stages of ponderosa pine and multi-strata stages of Douglas-fir and western larch, and riparian cottonwood woodlands). In the Blue Mountains, 72% of watersheds have experienced >60% reduction in source habitats when compared to historical conditions.

The Lewis' woodpecker is known to occur in the analysis area. Observations (individuals and reproduction) have been recorded in the western portion of the analysis area associated with the Wheeler Point Fire. It is likely that this species occurs elsewhere in the analysis area based on the presence of suitable dry upland forest stands.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

In the short term, there would be no change in existing Lewis' woodpecker habitat. In the mid and long term, shade tolerant (fire intolerant) tree species would continue to encroach into historically open ponderosa pine and Douglas-fir habitats. The composition of these stands would change; a higher proportion of shade tolerant tree species would be present in these stands. Increased stand densities would increase competition for resources and stress, making stands more susceptible to insects, wildfire, and disease. While it is expected that mixed severity fire would occur, there would be larger patches of high severity impacts (due to higher flame lengths and resulting passive crown fire) than would have been expected historically. Post fire habitats would be utilized by this species for both foraging and nesting.

Common to All Action Alternatives

Direct and Indirect Effects

Generally, the effects associated with each of the action alternatives on the Lewis' woodpecker and its habitat would be the same; only the extent, or the number of acres treated, would vary between alternatives. Commercial thinning (with skips and gaps) would occur in currently suitable Lewis' woodpecker habitat. Treatment would not convert suitable habitat to an unsuitable condition. Treatment activities would reduce stand densities in treatment units, shifting these stands to a more appropriate dry forest composition and structure. Tree species uncharacteristic of old forest single-stratum ponderosa pine habitats would be targeted for removal. Old (>150 years) ponderosa pine and Douglas-fir trees with old growth structural features, and smaller more vigorous trees would be favored for retention. Treatment would significantly reduce stand densities in affected units. Reduced stand densities would improve stand health and stimulate growth in residual trees. Skip-gap commercial thinning would provide for heterogeneity within treated stands; individual trees would provide for perching habitat, while larger clumps and skips would provide for endemic or greater insect densities that would be utilized by this species. These stands would also be more susceptible to fire, which would create nesting structure and perches. In the mid and long term, these stands would provide excellent foraging and nesting habitat for this species, and provide large diameter trees for perching.

Felling of hazard/danger trees within units and along roads used to access proposed harvest units may impact potential nest substrates. Snags in later stages of decay would be more likely to be felled than solid snags. Although potential nest snags may be felled for safety, existing large snags would be retained to the greatest extent possible, and all old (>150 years) trees and those exhibiting old growth character would be retained in commercial thinning units. It is not expected that this short term reduction in potential nesting snags would measurably impact the Lewis' woodpecker, the suitability of Lewis's woodpecker habitat, or measurably impact the availability of potential nesting snags in the snag analysis area (see *MIS: Primary Cavity Excavator* section).

Because burning would occur on the same number of acres (approximately 31,000) under all of the action alternatives, the effects of burning under these alternatives would be virtually the same. Burning has the potential to reduce potential nesting habitat through the consumption of snags. Research indicates that burning (with no prior treatment and with prior thinning) in similar habitats resulted in a loss of snags on affected acres (Hessburg et al. 2010, Harrod et al. 2009). These studies found that the vast majority of snags lost to burning were small diameter (<10" dbh); impacts to large snags were relatively minor (Hessburg et al. 2010, Harrod et al. 2009). Thies and others (2008) found that up to 5% of large trees and up to 14% of all trees in pine stands that were prescribed burned were killed immediately or died in the 3 years following burning. Burning is also expected to create snags; losses of existing snags would be offset or exceeded by new snag creation (Hessburg et al. 2010, Harrod et al. 2009). Burning in the Kahler analysis area is expected to have similar impacts as those described above due to the similar habitat conditions and the proposed intensity, timing, and mosaic nature of underburns.

New temporary road construction (Alternatives 2 and 3 only) and new system road construction would occur under all of the action alternatives. Temporary and new system roads would follow existing skid trails or utilize existing openings where possible. Impacts to overstory vegetation and snags would therefore be minimal, and generally associated with hazard tree abatement. This activity would not alter habitat suitability for this species.

Cumulative Effects

Temporal bounding of the cumulative effects analysis area generally goes 40 years into the past; the following analysis includes fire suppression activities that date back as far as the early 1900s. Past activities, actions, and events that affected the Lewis' woodpecker and its habitat include timber harvest, fire suppression, wildfire, and post-fire salvage. Past timber harvest targeted large diameter open-grown (single-strata) ponderosa pine and Douglas-fir that this species is dependent on for foraging and nesting. Harvest also impacted large diameter snags, reducing potential nesting habitat. Fire suppression has allowed for the encroachment of fire-intolerant conifer species into historically open ponderosa pine and Douglas-fir stands. The composition and structure of these stands has changed, reducing the quality of these stands for the Lewis' woodpecker. Fire salvage in the Wheeler Point Fire area also impacted potential nesting and foraging habitat in the high severity portion of the fire. Research indicates that this species utilizes post-fire stands where available, generally 5 to 10 years post-fire. Salvaged stands in the Wheeler Point Fire area would not be considered suitable habitat for this species due to the level of snag removal that occurred. These activities, actions, and events have combined to create the existing condition of Lewis' woodpecker habitat in the analysis area.

Ongoing (present) activities in the analysis area that are affecting the Lewis' woodpecker or its habitat include fire suppression. This activity is having the same effects as those described previously.

When the effects of these alternatives are combined with the residual and expected effects of past, present, and future activities in the analysis area, there would be no cumulative reduction in suitable habitat for the Lewis' woodpecker. Although habitat quality may be reduced to a small degree due to harvest activities and felling of hazard and danger trees, all of the action alternatives would positively impact habitat for this species in the mid and long term, reversing past habitat reductions. When combined with past harvest activities, there would be a reduction in large snags immediately and in the mid and long term through a reduction in snag recruitment. By moving these stands toward a condition more characteristic of historical conditions and improving stand health, the proposed vegetative treatment activities may reduce long term snag recruitment to an unknown degree. It is possible that Forest Plan standards for snag density would not be met in treated stands for some period of time. When combined with past activities, it is not expected that there would be an adverse cumulative impact on this species (due to reductions in large snags) due to the fact that existing snags would largely be retained in treatment units, and snag recruitment in post-treatment stands would be expected to be similar to that which occurred historically in dry forest stands. The availability of post-fire snag habitat is not expected to be cumulatively reduced due to the fact that fire risk in treated stands would not be eliminated. In addition, areas outside of treatment units (including riparian areas, Dedicated Old Growth, and other areas) would remain susceptible to high severity wildfire (within a larger mixed severity matrix) due to vegetative structure and composition and disturbance factors such as insects and disease.

Alternative 2

Direct and Indirect Effects

This alternative would have similar impacts as those described in the *Common to All Action Alternatives* section. This alternative would commercially thin (with skips and gaps) the most acres when compared to the other action alternatives. Approximately 380 acres would be moved into a single-stratum late and old structure condition in the short term, for a total of 1,830 acres of old forest single-stratum structure stands after treatment. In the long term (year 2065 – see Silviculture Report), it is projected that there would be 10,510 acres of old forest single-stratum structure stands in the analysis area. Much of this would be the result of thinning that moves younger stands into an intermediate structure and density, the application of prescribed burning on a regular basis (10-20 year interval), and growth over time. Because this alternative would move the most acres into or toward an OFSS condition in the short and long term, it would have the greatest short and long term impact on the availability and distribution of suitable Lewis' woodpecker habitat in the analysis area. See discussion in the *White-headed Woodpecker* Section. Because this alternative would treat the most acres (overall and old forest acres), it would also have the most potential impact on snags (through hazard/danger tree felling), reductions in snag recruitment, and felling of large diameter, younger Douglas-fir and white fir that currently provide perches in proposed units.

Cumulative Effects

The cumulative effects of this alternative would be similar to those described in the *Common to All Action Alternatives* section. This alternative would treat the most acres of potential Lewis' woodpecker habitat when compared to the other action alternatives. Alternative 2 would contribute the most to past losses of snags potentially used for nesting. This alternative would reverse the effects of past fire suppression (by returning dry forest stands to appropriate structure and composition) on more acres than the other action alternatives.

Alternative 3

Direct and Indirect Effects

This alternative would move the same number of acres of OFMS into an OFSS structural condition in the short term as was described under Alternative 2. In the long term (year 2065 – see Silviculture Report), it is projected that there would be 9,970 acres of old forest single-stratum structure stands in the analysis area. Alternative 3 would move approximately 540 fewer acres into an OFSS condition in the long term when compared to Alternative 2. While still below HRV, this structural stage would be available at similar levels as those that would be expected historically, but at a slightly lesser proportion than Alternative 2.

Because this alternative would treat fewer acres (overall and old forest acres) and require less road use (closed, seasonal, and existing/new temporary roads), the potential short and long term impacts on snags (through hazard and danger tree felling and reductions in future recruitment) would be less than Alternative 2. This alternative would also result in less impact to large diameter, younger grand fir and Douglas-fir that are currently providing perching habitat. This alternative would also drop four proposed units in the Wheeler Point Fire area that currently provide suitable habitat for this species. Further treatment of these suitable stands (beyond what the fire accomplished) would reduce snag recruitment in the future, and may disrupt breeding in known occupied habitat.

Cumulative Effects

This alternative would have slightly less cumulative impact on snags due to there being less mechanical treatment in potential habitat. It would also reverse past habitat changes resulting from fire suppression on slightly fewer acres than Alternative 2.

Alternative 4

Direct and Indirect Effects

This alternative would move 380 acres of OFMS into an OFSS structural condition in the short term (the same as Alternatives 2 and 3). In the long term (year 2065 – see Silviculture Report), it is projected that there would be 8,880 acres of old forest single-stratum structure stands in the analysis area. In both the short and long term, this would be fewer acres than would be expected under Alternatives 2 and 3. While still below HRV, this structural stage would be available at similar levels as those that would be expected historically, but at a slightly lesser proportion than Alternatives 2 and 3.

Because this alternative would treat the fewest acres (overall and old forest acres) and require the least road use (closed, seasonal, and existing temporary roads), the potential short and long term impacts on snags (through hazard and danger tree felling and reductions in future recruitment) would be the least when compared to the other action alternatives. This alternative would also result in the least impact to large diameter, younger grand fir and Douglas-fir that are currently providing perching habitat.

Cumulative Effects

The cumulative impacts of this alternative would be the least when compared to the other action alternatives due to the fact that it would mechanically treat the fewest acres of existing and potential Lewis' woodpecker habitat. It would also reverse past habitat changes resulting from fire suppression on fewer acres than Alternatives 2 and 3.

Determination and Rationale (All Action Alternatives)

These alternatives may impact individuals or habitat, but are not likely to contribute to a trend towards federal listing or cause a loss of viability to the population or species. The rationale for this determination is as follows:

- The Lewis' woodpecker is present in the analysis area.
- Commercial thinning (with skips and gaps) generally would not alter the

suitability of habitat in the analysis area. Habitat quality would improve in capable, unoccupied habitat in the short and long term through the proposed activities. Stand structure and composition would emulate what historically occurred in dry forest habitat.

- Future snag recruitment may be impacted through a reduction in density-dependent mortality. As treated stands would be moved into a more appropriate dry forest structure and composition (moving toward the HRV), and impacts to existing snags are expected to be minor, this long term impact to snags is not expected to adversely impact this species or potential habitat. Snag recruitment in post-treatment stands would be expected to be similar to that which occurred historically.
- Mechanical treatment of suitable habitat and landscape burning would have minor short and mid term impacts on snags potentially used for nesting and roosting.

GRAY WOLF

AFFECTED ENVIRONMENT

Gray wolves (*Canis lupus*) are the largest wild members of the dog family (Canidae). The wolf is a habitat generalist inhabiting a variety of plant communities, typically containing a mix of forested and open areas with a variety of topographic features (Verts and Carraway 1998). Suitable habitats are those that have a high proportion of forested cover and public lands, high elk densities, low road densities, and low livestock densities (NatureServe 2014, Oakleaf et al. *in* USDI 2009c). The gray wolf prefers areas with few roads, generally avoiding areas with an open road density greater than one mile per square mile (NatureServe 2014). Research indicates that inventoried roadless areas (other undesignated roadless areas were not considered in this science) contribute to biodiversity and habitat connectivity and provide important habitats for the conservation of threatened and endangered wildlife (Crist et al. 2005, Loucks et al. 2003, DeVelice and Martin 2001) when combined with other protected areas (wilderness and National Park lands). Packs typically occupy large distinct territories from 200 to 500 square miles and defend these areas from other wolves or packs.

In 1974, two subspecies of gray wolf were listed under the Endangered Species Act as endangered (39 FR 1171, January 4, 1974). In 1978, the gray wolf was relisted at the species level throughout the majority of the conterminous 48 States (43 FR 9607, USDI 1978). On November 22, 1994, portions of Idaho, Montana, and Wyoming were designated as nonessential experimental population areas for the gray wolf (59 FR 60252 and 60266, November 22, 1994). The Northern Rocky Mountain Wolf Recovery Plan was completed in 1980 and revised in 1987. The revised recovery plan established population recovery goals for the Northern Rocky Mountain gray wolf in 3 distinct recovery areas: northwestern Montana, Central Idaho, and the Yellowstone National Park area. The NRM wolf population achieved its numerical, distributional, and temporal portions of the recovery goal in 2002 (74 FR 15124, USDI 2009b). Subsequently, the US Fish and Wildlife Service identified the Northern Rocky Mountain Distinct Population segment (DPS) and delisted the Northern Rocky Mountain DPS (as described, except for Wyoming) in 2009 (74 FR 15123, USDI 2009b). The rule delisting the NRM gray wolf was overturned on August 5, 2010 through a U.S. District Court ruling. Effective May 5, 2011, the US Fish and Wildlife Service reinstated the terms of the 2009 final rule that removed the gray wolf from the Federal Endangered Species List in a portion of the Northern Rocky Mountain Distinct Population Segment, as directed by the FY 2011 Appropriations Bill. Currently, the gray wolf is considered a Region 6 Sensitive Species on that portion of the Umatilla National Forest east of State Highway 395 and federally listed as Endangered west of State Highway 395. The wolf is classified as Endangered in the Kahler analysis area. No critical habitat has been proposed or designated in the Northern Rocky Mountains (USDI 2009a).

There are currently nine wolf packs known to occur in northeast Oregon; none are located on the Heppner Ranger District. The US Fish and Wildlife Service believes that packs that may become established in the eastern half of Oregon would have an inherently small role in the overall conservation of the NRM DPS due to the small amount of habitat available in the Oregon portion of the DPS and the limited number of packs that this habitat would support (74 FR 15173, USDI 2009b).

The gray wolf was on the species lists provided by the US Fish and Wildlife Service identifying listed species with a potential to occur in Wheeler and Grant Counties (USDI 2014a). Unconfirmed sightings of gray wolves have occurred on the District in the past several years. These sightings have been investigated by the US Fish and Wildlife Service, Oregon Department of Fish and Wildlife, and the Forest Service. In December of 2014 the Oregon Department of Fish and Wildlife confirmed a new Area of Known Wolf Activity (AKWA) in the Desolation Unit on the adjacent North Fork John Day Ranger District. At this time, ODFW has little data regarding the specifics of this new pair (i.e., sex, breeding status, and specific use area) besides the fact that they are resident. The new AKWA is approximately 30 miles east of the Kahler planning area.

No denning or rendezvous sites are known to occur on the District. Potential habitat in the analysis area would be considered marginal at best due to open road densities and associated disturbance. It is expected that dispersal from core areas to the east and from established packs in northeast Oregon will continue in the future.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

The quality of potential gray wolf habitat is not expected to change in the short term. In the mid and long term, open road densities are not expected to change. Big game populations (prey) are also expected to be relatively stable in the mid and long term (meeting or near state management objectives), barring large scale disturbance. It is unlikely given current and expected future management in the analysis area that the gray wolf would establish a territory in the Kahler area.

Common to All Action Alternatives

Direct and Indirect Effects

Vegetative treatments (commercial and noncommercial thinning) and burning would not directly affect the gray wolf because this species is not known to occur in the analysis area or on the District. Dens and rendezvous sites would also not be affected by the proposed activities because neither of these features is present on the District. Wolves are habitat generalists; commercial thinning, non-commercial thinning, and burning would not directly impact potential habitat quality. The proposed activities would not occur in or impact inventoried roadless areas, scenic areas, wilderness, or potential wilderness in the vicinity of the analysis area. Under all of the action alternatives, open road densities would decrease. While human disturbance associated with vehicle use would decrease following implementation of new road closures, the average open road density in the analysis area would continue to be above levels desired by the gray wolf. It would remain unlikely that the gray wolf would establish a territory in the analysis area.

Road closures (seasonal and year-round) associated with treatment activities, totaling 16.5 miles under Alternative 2, 15.6 miles under Alternative 3, and 15.7 miles under Alternative 4, would temper cover loss to some degree by creating low-disturbance areas associated with treated and untreated stands in the Kahler area. Population levels of prey in the vicinity of the project area are not expected to measurably change. Potential prey (elk) would likely spend a greater amount of time on adjacent private lands or adjacent National Forest System lands in response to treatment activities.

Cumulative Effects

Past activities and events in the analysis area that affected potential prey resources and the level of human disturbance in the analysis area include timber harvest, road construction, and road closures (Access and Travel Management Planning). Timber harvest has affected forest structure and composition. This activity impacted habitat for potential prey by reducing the amount of cover habitat in the analysis area. Conversely, the amount of foraging habitat for big game has increased in response to past harvest. Currently, the HEI standard for the E1 West and E1 East management area is being met; it is not being met in the C3 management area. Total cover and satisfactory cover standards are also not being met in the C3 management area. Road construction associated with timber harvest increased road densities and disturbance within the analysis area. The current open road density in the analysis area is 2.0 and 2.5 miles per square mile in the E1 management area (East and West, respectively), and 0.5 miles per square mile in the winter range (MA C3 during the winter use period of December 1 through April 14). Due to the fact that wolves generally prefer habitat with less than 1 mile of open road per square mile, much of the project area would be considered poor quality potential gray wolf habitat. In the 1990s, road closures associated with access and travel management planning on the south end of the Umatilla National Forest reduced road densities to their existing condition. Prior to this, most of the roads on the District were open to motorized use. Past activities have resulted in the current condition of gray wolf habitat in the analysis area.

There are no ongoing or reasonably foreseeable future activities, actions, and events that would affect potential wolf habitat or potential prey resources in the analysis area.

When the expected effects of these alternatives are combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be no cumulative impacts on this species (it is not present), and no cumulative reduction in potential gray wolf habitat. Wolves are a habitat generalist; prey resources and disturbance (or lack thereof) are much better indicators of habitat suitability than vegetation. Vegetative treatment would not alter habitat suitability. Road closures proposed under all of the action alternatives would help reverse past and ongoing disturbance associated with construction and use of the existing road system in the analysis area. Treatment activities would cumulatively impact potential prey (elk) habitat and distribution.

Determination and Rationale (Alternatives 2, 3, and 4)

Under all of the action alternatives, there would be no effect on the gray wolf. The rationale for this determination is as follows:

- The gray wolf is not currently known to occur in the Kahler analysis area or on the District.
- Open road densities would decrease under all of the action alternatives; however, densities would remain above what is generally desired by wolves. There would

be no treatment in inventoried roadless, scenic areas, potential wilderness, and designated wilderness areas under these alternatives.
- Potential prey would continue to occur in the area at similar population levels as those that currently occur in the project area. Distribution of potential prey may shift as a result of treatment activities.

INTERMOUNTAIN SULPHUR (BUTTERFLY)

AFFECTED ENVIRONMENT

The intermountain sulphur butterfly inhabits open woodland from 3,400 to 5,000 feet in elevation, including meadows, roadsides, and open forest. Warren (2005) states that members of this subspecies are most often found on steep sunny slopes at the ecotone between forest and shrub-steppe or grassland habitats. Habitat for this species includes sagebrush with scattered ponderosa pine, including both south and east facing slopes. The larvae of this subspecies feed on *Lathyrus* (sweat pea) species. This species has an unknown status at the National Level, and has not been evaluated for the state of Oregon (NatureServe 2014). This species is found from the eastern Blue Mountains in Washington, through the Blue and Ochoco Mountains in Oregon, along the Snake River in Idaho, and south into western Utah. Although all known Oregon locations are situated east of the Forest, this species is suspected to occur on the Umatilla National Forest. Loss of habitat due to agricultural conversion and development are the primary threats to this species. Pesticide use, especially aerial applications, also poses serious threats to this species.

There have been no surveys for this species on the District. There have also been no known incidental observations of this species on the District. Potential habitat for this species is present in the analysis area. Based on the fact that potential habitat is present, this species is assumed present in the analysis area.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

The quality of potential intermountain sulphur habitat is not expected to change in the short term. Suitable habitat for this species is located at the ecotone between steppe-shrubland and grassland habitats and forested sites. The structure and composition of these habitats generally does not change over short time periods. In the mid and long term, continued encroachment of steppe-shrubland and grassland habitats by conifer species (primarily juniper with lesser amounts of ponderosa pine and Douglas-fir) would alter the structure and composition of these habitats. Wildfire impacts to this habitat type would be relatively short-lived, as grassland habitats recover quickly after disturbance. The shrub component of these habitats would require a longer recovery period, but as this species utilizes forb species for foraging and reproduction, effects would only persist in the short term.

Common to All Action Alternatives

Direct and Indirect Effects

Under all of the action alternatives, there would be treatment of encroaching conifers in steppe-shrubland sites. Removal of smaller-diameter, younger conifers from areas where they were less abundant historically would improve the structure and composition of steppe shrubland habitat. Under all of the action alternatives there would be approximately 1,500 acres of ground-based mechanical thinning to improve steppe shrubland habitat. In the short term, the use of mechanical skidding equipment in a portion of these stands would cause disturbance to existing herbaceous vegetation and shrubs. The disturbance that would occur in individual units would vary greatly according the amount of encroaching conifers that are present. It is expected that vegetation would recover quickly; these impacts would persist for perhaps one to two growing seasons. Mechanical treatment has the potential to directly affect this species (juveniles and eggs) during implementation. During the summer months, larvae would be actively feeding on *Lathyrus* species in steppe shrubland and grassland sites. Eggs would also be vulnerable to impacts during the winter. Due to the fact that only a portion of the unit acres would be affected by skidding operations, the impact to potential larvae and eggs is expected to be minor. Proposed landscape underburning would impact approximately 31,000 acres within the analysis area. Broadcast underburning would preferably occur in the fall; however, spring burning may occur if weather and fuel conditions combine to create conditions where goals and objectives of burning would be met. Spring burning may impact habitat by reducing potential larval host plants; however, most larvae would have metamorphosed by the time a burn window opened in the fall. The burn area is composed of a number of blocks that utilize existing roads and features to compartmentalize the burn area. Adjacent blocks generally would not be burned in the same year in order to provide a mosaic of burned and unburned habitat across the project area. A reasonable estimation of yearly underburning would be approximately 1,000 to 2,000 acres, of which approximately 70% of the area would actually be blackened. Because burning would not occur in a single calendar year, potential impacts to this species and its habitat would be spread over a longer time period. Habitat for this species would recover in the next year following burning.

It is expected that in the mid and long term, steppe-shrubland treatments would improve potential habitat quality for this species by reducing competition with encroaching conifers for light, water, and other resources, and reducing allelopathic interactions. These habitats would have a composition and structure more similar to what would have been expected historically.

New temporary road construction (Alternatives 2 and 3) and clearing of some existing temporary roads would impact habitat for this species. New temporary road construction would impact a maximum of 5.5 acres, with only a portion of this composed of potential habitat. It is not expected that this level of impact on potential habitat would appreciably impact this species, if present in the analysis area. In the long term, new temporary roads and cleared existing temporary roads would recover and provide potential habitat for this species.

Cumulative Effects

Past activities and events in the analysis area that affected potential intermountain sulphur habitat include livestock grazing, road construction, and prescribed underburning. Past grazing occurred at much higher stocking levels than those currently occurring; overutilization and limited forage likely resulted in greater utilization of forbs, including preferred food plants and larval host plants. The time that has passed since overgrazing has likely eliminated any residual impacts associated with this activity. Prescribed underburning directly impacted the quality of potential habitat. However, these impacts were temporary due to the fact that these underburns were low intensity and habitat (larval host plants) likely fully recovered in the season following burning. Road construction occurred in open steppe-shrubland and grassland habitats in the analysis area in the past. This activity permanently removed impacted acres from production. These activities, actions, and events have combined to create the existing condition of intermountain sulphur habitat in the analysis area.

Ongoing and reasonably foreseeable future activities with a potential to impact potential intermountain sulphur habitat include cattle grazing and prescribed fire (Wildcat II, Sunflower Bacon, and Rimrock Projects). Due to the fact that a small portion of cattle diets are comprised of forbs, that the larval host plant (sweet pea) is low growing and may be difficult for cattle to access, and impacts to upland vegetation have been slight to light and consistently met Forest Plan standards, the current and expected impacts to potential intermountain sulphur habitat would be minor.

When the expected effects of these alternatives are combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be no cumulative reduction in habitat for this species or adverse impacts to the species. Expected impacts to potential habitat quality would be temporary, and would be spread through both time and space. Because burning would occur over five to ten years across the analysis area, it is not expected that there would be an adverse cumulative impact on this species (if present).

Determination and Rationale (All Action Alternatives)

Under all of the action alternatives, the proposed activities may impact individuals or habitat, but are not likely to contribute to a trend towards federal listing or cause a loss of viability to the population or species. The rationale for this determination is as follows:

- The intermountain sulphur is not known to occur in the analysis area.
- Commercial and non-commercial thinning to improve steppe-shrubland habitat conditions have the potential to impact habitat in the short term; mechanical treatment activities may result in physical damage/crushing of juveniles and eggs. Based on the expected extent of impacts within proposed steppe-shrubland improvement units, it is unlikely that population levels (if this species is present) would be impacted.
- In the mid and long term, the structure and composition of steppe shrubland habitat would improve with regard to the requirements of this species.
- Burning would affect habitat quality in the short term. Due to the intensity, timing, and mosaic nature of proposed underburns, and the fact that burning would be spread over the analysis area over a number of years, it is not expected that this species or potential habitat would be adversely impacted.

JOHNSON'S HAIRSTREAK (BUTTERFLY)

AFFECTED ENVIRONMENT

Larvae of this butterfly are associated with coniferous forests that contain mistletoes of the genus *Arceuthobium* (dwarf mistletoes). Adults feed on a variety of nectar flowers. This species is considered to be an obligate old growth butterfly; due to their association with and tendency to reside in the forest canopy, this species is not often encountered. This species will also use late successional second growth forests. The Johnson's hairstreak is globally ranked as G3G4 (Vulnerable/Apparently Secure) (NatureServe 2014). Its status is uncertain; it is vulnerable and at moderate risk of extinction due to a restricted range, relatively few populations, recent or widespread declines, or other factors, or it is uncommon but not rare. Due to declines or other factors there is some cause for long-term concern. In Oregon this species of butterfly is ranked S2 (imperiled) (NatureServe 2014). Scattered sightings of this species have occurred in the Blue Mountains, Wallowa Mountains, Siskiyou Mountains, the Coast Range, and the Cascade

Mountains. The current range of the butterfly is not well understood, as most observations tend to be old. This species has been observed on the Umatilla National Forest (Walla Walla Ranger District). Threats to this species include habitat destruction (timber harvest, sanitation harvest, fire, etc.) and application of pesticides (including BTK bacterium) and herbicides.

Surveys for this species were initiated in the summer 2012 on the Heppner and North Fork John Day Ranger Districts. Host plant material was collected from 11 sites in suitable habitat areas on the Heppner District. Eight of the sites were located in the Kahler analysis area. Genetic analysis of possible Johnson's hairstreak larvae found that they were the closely-related thicket hairstreak. Old forest stands and dense second growth stands containing dwarf mistletoe are present in the analysis area. Occasional heavy infestations of mistletoe are present in the analysis area. While this species was not found during surveys, it is possible that it is present on the District and in the Kahler analysis area.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

The quality of potential Johnson's hairstreak habitat is not expected to change in the short term. In the mid and long term, habitat for this species would increase in some areas and decrease in others. Continued fire suppression would allow for the continued ingrowth of small diameter conifers in dry forest stands. Infection of understory conifers with dwarf mistletoe would increase larval habitat for this species. Mixed severity fire (with larger patches of high severity impacts than would have been expected historically) would cause varying levels of overstory mortality, which could lead to reductions in the availability and distribution of mistletoe at the small scale.

Common to All Action Alternatives

Direct and Indirect Effects

Under all of the action alternatives, trees infected with dwarf mistletoe would be targeted for removal in commercial thin units to improve stand health and slow the spread of dwarf mistletoe to understory vegetation. All old trees (>150 years old), regardless of size, would be retained. A portion of existing Douglas-fir and grand fir that are greater than 21 inches dbh, but less than 150 years old may be removed in proposed treatment units under Alternatives 2 and 3. Removal of large diameter (but young) Douglas-fir and grand fir would impact potential habitat used by this species during the spring and summer flight season. Loss of mistletoe infected trees in general would reduce potential foraging habitat for this species. The prescription that would be applied to proposed units incorporates both skips and gaps within the larger treated matrix within each treatment unit. Skips would account for approximately 10 to 15 percent of the proposed treatment acres within each unit; in general, these would be dense patches within the stands. Skips (untreated areas) would provide for locally high levels of mistletoe infection within the proposed treatment unit, as well as scattered large diameter and smaller dwarf mistletoe infected trees. Danger tree felling would also likely impact mistletoe infected trees to some extent; those trees with dead mistletoe brooms that have the potential to interact with traffic on roads may be felled. While potential larval forage may be reduced to some degree, dwarf mistletoe would still be available within proposed commercial thinning units following implementation. These trees, in addition to those infected trees located outside of proposed vegetative treatment units, would provide forage for this species, if present.

Non-commercial thinning may also impact dwarf mistletoe infected trees to a small degree. Generally, larger trees are used for egg deposition due to more numerous and larger mistletoe clumps (i.e., fruiting bodies), so the expected impact in non-commercial thinning would be minor.

Prescribed underburning is not expected to appreciably impact dwarf mistletoe abundance or distribution. The low intensity of these burns would make it unlikely that the abundance of overstory trees potentially used by this species for larval feeding would be appreciably impacted.

Cumulative Effects

Past activities, actions, and events in the Kahler analysis area that have impacted potential Johnson's hairstreak habitat include fire suppression, timber harvest, and wildfire (Wheeler Point). Fire suppression has likely allowed dwarf mistletoe to become more widespread and infections more severe within the analysis area and the larger landscape. Past harvest activities impacted potential Johnson's hairstreak habitat through direct removal of mistletoe infected trees of all size classes. Although mistletoe was targeted for removal in treatment units, areas outside of treatment units currently contain dwarf mistletoe infected trees. Past wildfire also impacted potential habitat by eliminating dwarf mistletoe over larger areas. These activities have combined to create the existing condition of Johnson's hairstreak habitat in the analysis area.

There are currently no ongoing or reasonably foreseeable future activities, actions, and events in the analysis area that are affecting Johnson's hairstreak habitat.

When the expected effects of these alternatives are combined with the residual and expected effects of past, present, and future actions, activities, and events in the analysis area, there would be an incremental reduction in potential larval foraging habitat in treatment units. However, mistletoe would likely continue to be more widespread than would be expected under historic conditions. Mistletoe infected trees are expected to be present in treatment units (general matrix, skips) following implementation. Impacts to mistletoe trees outside of treatment units would be considered minor due to the low level of impact expected during prescribed burning, and the fact that only those mistletoe infected trees that rate out as a danger to users of roads (using the 2008 Danger Tree Identification Guide) would be felled. For these reasons, it is not expected that there would be a shortage of potential larval foraging habitat after implementation.

Determination and Rationale (All Action Alternatives)

Under all of the action alternatives, the proposed activities may impact individuals or habitat, but are not likely to contribute to a trend towards federal listing or cause a loss of viability to the population or species. The rationale for this determination is as follows:

- The Johnson's hairstreak butterfly is not known to occur in the analysis area; it is assumed present based on the presence of suitable habitat.
- Commercial thinning, and to a much lesser degree non-commercial thinning, would impact the larval host plant (dwarf mistletoe). Potential larval foraging habitat would be available within and outside of proposed treatment units following implementation.
- Burning would have minor impacts on dwarf mistletoe infected trees; an occasional infected tree may be killed.
- The impacts of danger tree felling are also expected to be minor given guidelines in the 2008 Danger Tree Identification Guide.

OTHER SPECIES

These are species that are “of interest” to the public at the local or regional level, or were identified as a species of concern by the US Fish and Wildlife Service. Occurrence determinations are based on observation records, vegetative and wildlife species inventory and monitoring, published literature on the distribution and habitat utilization of wildlife species, and the experience and professional judgment of wildlife biologists on the Umatilla National Forest.

NORTHERN GOSHAWK

AFFECTED ENVIRONMENT

Research indicates that in Oregon, goshawk select for older coniferous stands with larger diameter trees than other accipiter species (NatureServe 2014, Moore and Henny 1983). Greenwald and others (2005) reviewed existing research on goshawk habitat selection and concluded that goshawk select (use at a greater proportion than its availability) late successional forest (and associated large diameter trees, multiple canopy layers, abundant woody debris, and high canopy closure (mean = 40% canopy closure)) within their home ranges. Dense late and old structure forest habitat is clearly important in close proximity to nest locations, but has been found to decrease in relative abundance with increasing distance from the nest (Daw and DeStefano 2001); successful nesting also occurs in mid aged dense canopy stands and occasionally in open-canopied stands in northeast Oregon (Daw and DeStefano 2001). While goshawk show a strong selection for mature stands for nesting, they will utilize a broad range of stem densities, age classes, and canopy closures (Beier and Drennan 1997, Daw and DeStefano 2001, Greenwald et al. 2005), they tend to avoid openings (including new clear-cuts) and young, early seral stands (generally <30 years old)(Greenwald et al. 2005). Existing research indicates that a mix of age classes and forest seral stages (including dense canopy forest and more open, younger stands) provide hunting cover, protection from predators, and habitat for abundant prey, including those characteristic of both dense and more open habitat types (Reynolds et al. 1992, Daw and DeStefano 2001, Wiens et al. 2006). Nesting sites typically consist of a dense cluster of large trees and is generally situated in close proximity to a stream or other water source (Daw and DeStefano 2001). Potential foraging and nesting habitat is present in the analysis area. Table W-33 shows the existing condition of goshawk habitat in the analysis area.

Table W-33. Suitable northern goshawk habitat in the Kahler analysis area.

Northern Goshawk Habitat Type	Existing Habitat (acres)
Reproductive	1,797
Forage	21,344
TOTAL HABITAT	23,141

There are approximately 1,797 acres of suitable nesting habitat and 21,344 acres of suitable foraging habitat in the analysis area (queried from GIS database). The mean size of potential nesting habitat stands is 24 acres; the largest individual stand is 90 acres in size. Nesting habitat tends to be closely associated with riparian habitats and dense dry and moist upland forest stands. Nesting habitat is scattered in patches across the entire project area. Potential foraging habitat is located throughout the analysis area

No active or historic northern goshawk nests are known to exist in the analysis area. No active or historic goshawk nests were encountered during reconnaissance of the analysis area during spring and summer 2013. Goshawk were observed at several locations, including Units 23 and 99, during examination of potential treatment units.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

Potential nesting and foraging habitat would remain unchanged in the short term. In the mid and long term, stands would continue to grow and develop multiple dense canopy layers. Young stands would develop large trees over time. Openings created by past harvest and wildfire would fill in over time. The availability of nesting habitat would increase slightly in the long term due to a greater abundance of large trees and dense multi-layered habitat in dry forest stands. Foraging habitat quality would change as the area grows denser and more homogeneous, resulting in fewer microhabitats for prey species. The multi-layer condition would increase the susceptibility of stands to insects, wildfire, and disease outbreaks. While it is expected that mixed severity fire would occur, there would be larger patches of high severity impacts (due to higher flame lengths and resulting passive crown fire) than would have been expected historically. Suitable nesting and foraging habitat would be converted to an unsuitable condition by a high severity fire.

Common to All Action Alternatives

Direct and Indirect Effects

Proposed commercial harvest (with skips and gaps) would have the same effects on the northern goshawk and goshawk habitat under each of the action alternatives; the extent of these activities would vary by alternative. It is this difference in acres treated that would result in varying levels of impact to the goshawk and its habitat. Since potential habitat quality would be affected by proposed commercial thinning it stands to reason that an increase in the acres impacted by these activities would have a greater impact on potential goshawk habitat.

There are no known northern goshawk nests in the project area. In the event that a northern goshawk nest is discovered in the project area during layout or implementation, treatments would be adjusted to meet the guidelines provided in the Eastside Screens (USDA 1995) and Forest Plan. This would include identification of a 30 acre nest stand immediately surrounding the nest, and a 400 acre post-fledging area for active nests. Harvest would not be allowed within the 30 acre nest stand.

Vegetative treatment activities (commercial thinning, shrub-steppe enhancement, and non-commercial thinning) would occur in suitable goshawk habitat under all of the action alternatives. Refer to Table W-34 for acres of treatment by habitat type (nesting and foraging) and treatment type.

Table W-34. Acres of northern goshawk habitat treated by habitat type and treatment type.

Habitat Type	Alternative	Acres Treated	Treatment Type		
			Commercial Thinning	Shrub Steppe Enhancement	Non-Comm Thinning
Nesting	Alternative 2	1,151	1,107	13	31

	Alternative 3	981	892	13	76
	Alternative 4	737	648	13	76
Foraging	Alternative 2	11,481	9,599	1,163	719
	Alternative 3	10,823	8,788	1,163	872
	Alternative 4	9,817	7,882	1113	822

Under all of the action alternatives, suitable goshawk nesting and foraging habitat would be commercially thinned. Goshawk prefer to nest in larger diameter trees in stands that generally have at least 40% canopy closure. Commercial harvest (with skips and gaps) would reduce canopy closure below this level (40%) in treated stands and reduce stand complexity (multi-layered profiles). As a result, goshawk would be less likely to use commercially thinned reproductive habitat for nesting post-implementation. These impacts would persist through the mid and long term in commercially thinned nesting habitat; over this period, residual trees would continue to grow and increase canopy closure and understory vegetation would regenerate. Although small skips would be retained in treatment units, it is unlikely that these skips would be of adequate size to support nesting activities in the short term. The removal of some young Douglas-fir and grand fir that are >21 inches in diameter that are interacting with desirable leave trees (ponderosa pine >16 inches dbh) has the potential to impact potential nest trees. As only a portion of these trees are expected to be removed, it is expected that larger diameter fir trees would be available for potential nesting in the long term. Treatment activities would improve the health and vigor of residual stands. In dry upland forest stands, treatment would promote or move stands into a more appropriate structure and composition.

Commercial thinning in suitable foraging habitat would also reduce canopy closure; however, goshawk use a wide range of structures, stand ages, and densities while foraging (Daw and DeStefano 2001). The goshawk would likely continue to use these stands post-treatment for foraging. Retention of skips (comprising 10 to 15 % of unit acres) within these commercially thinned stands would provide for a diversity of habitat for prey. Prey densities may be reduced in the short term as a result of ground disturbance and burning in these stands, but would likely be similar to pre-treatment levels in the mid term due to the diversity of habitat that will be available. Goshawk use may be reduced to some degree in the short and early mid term due to reductions in canopy closure resulting from treatment activities designed to move these stands towards a more appropriate dry forest composition and structure and short term disturbance of potential prey habitat. In the long term, canopy closure and understory vegetation layers would increase. Without further overstory treatment, commercially thinned foraging habitat would provide suitable nesting habitat in the long term (see Silviculture Report).

Burning would not impact potential goshawk nesting or foraging habitat suitability. Although an occasional large overstory tree or group of trees may be killed, this activity would not impact overall stand structure or composition (Harrod et al. 2009). Burning and mechanical activity fuels treatments (if necessary) are not expected to measurably reduce potential prey for the goshawk because landscape underburning is expected to blacken only a portion of the acres within the burn area. While it is difficult to predict where fire will and will not occur, it is estimated that approximately 70% of the burn area would actually be blackened. Because burns would be low intensity, it is expected that Forest Plan standards for large wood would be met following burning and contribute to habitat complexity and cover required by potential prey.

Road use (open and closed) and associated danger tree felling are not expected to impact the goshawk. If a nest is discovered during layout or implementation, seasonal road use restrictions would be applied in any instance where a road used for haul has the potential to disturb nesting goshawk. New temporary road construction would occur within foraging and nesting habitat under Alternatives 2 and 3. Because new temporary roads would generally follow existing openings (where available), impacts to overstory vegetation and goshawk habitat quality are expected to be minimal. Felling of danger trees along haul routes may impact a small number of larger diameter green trees that could potentially be used for nesting. Due to the proximity of these trees to roads and the availability of potential nesting trees elsewhere, it is unlikely that this activity would directly or indirectly impact this species.

Non-commercial thinning would not impact goshawk habitat quality. In the long term, this activity will promote the development of larger trees by stimulating growth in residual small diameter trees.

Shrub-steppe enhancement treatments would impact areas where historic shrublands and grasslands have been encroached by conifers, including juniper, ponderosa pine, and Douglas-fir. These areas would be quite open after treatment; only old, large trees would be retained in the overstory. These areas would not be used for nesting following treatment; potential foraging would likely be greatly reduced in these stands.

Cumulative Effects

Past activities, actions, and events in the Kahler analysis area that have impacted suitable goshawk habitat include commercial thinning and regeneration harvest, wildfire (Wheeler Point), fire suppression, and insect and disease outbreaks. Fire suppression has allowed for the ingrowth of shade-tolerant vegetation in upland forest stands, increasing canopy density and stand complexity (multiple layers). As a result, a larger proportion of dry forest stands provide suitable habitat conditions (canopy closure ≥ 40% and multiple canopy layers) than would have been expected under historic conditions. Past harvest activities have impacted the quality, quantity, and distribution of suitable goshawk habitat in the analysis area. These activities altered stand structure, reducing the amount of late and old structure habitat, and the size of available habitat patches. Large trees were generally targeted in these stands. In general, commercially thinned and regeneration harvested stands are not currently providing suitable nesting habitat due to a lack of large diameter green trees and complex stand structure. Past high and moderate severity wildfire also reduced the amount of suitable habitat within the analysis area. Insect outbreaks (spruce budworm) have resulted in high mortality of grand fir and Douglas-fir in small, relatively isolated moist upland forest stands and some overstocked dry forest stands. These events reduced suitable nesting habitat in some locations; conversely, foraging habitat quality may have improved to some degree in these stands. These activities have combined to create the existing condition of northern goshawk habitat in the analysis area.

Currently, there are no ongoing or reasonably foreseeable future activities proposed in the analysis area that would affect or have the potential to affect the goshawk or its habitat.

When the effects of this alternative are combined with the residual and expected effects of past, present, and future activities in the analysis area, there would be a cumulative reduction in suitable nesting habitat. This reduction would add to past losses in nesting habitat resulting from past harvest and wildfire, and reverse past increases in suitable nesting habitat resulting from fire suppression. Refer to individual alternative sections for further discussion. Foraging habitat would also be treated under all three action alternatives. Although the proposed activities may alter stand structure and composition and reduce prey in the short term, there would be no cumulative reduction in or adverse cumulative impact on suitable foraging habitat under any of the action alternatives. In the long term, treatment activities would maintain and promote development of the large tree component in affected stands, and promote the resilience of habitat to wildfire. The proposed activities would be consistent with Forest Plan standards and guidelines for goshawk habitat and late and old structure habitat (USDA 1995), and would continue to be so in the event a nest is discovered within the project area.

Alternative 2

Direct and Indirect Effects

This alternative would have similar effects to those described under the *Common to All Action Alternatives* section. This alternative would commercially thin and enhance shrub-steppe habitat on the most acres of suitable nesting and foraging habitat when compared to Alternatives 3 and 4 (Refer to Table W-39). For this reason, it would also have the greatest impact on goshawk habitat in the short and long term. Commercial thinning and shrub-steppe enhancement would make 1,120 acres of nesting habitat unsuitable for nesting. These acres are located in stands where the HRV indicates that more open dry upland forest vegetation dominated by ponderosa pine or openings and shrublands would have occurred historically. This would equate to a 62% reduction in suitable nesting habitat in the short and mid term. In the long term, without further treatment of overstory vegetation, it is expected that stands would again be encroached by fire-intolerant conifers and stand densities and canopy closure would increase. As a result, some stands would transition back to a suitable nesting habitat condition in this time frame (see Silviculture Report).

Foraging habitat quality would be impacted in the short and mid term on the most acres (11,481 acres) under this alternative.

Cumulative Effects

The cumulative impacts of this alternative would be similar to those described under the *Common to All Action Alternatives* section. This alternative would result in the greatest incremental reduction in suitable nesting habitat when combined with reductions in habitat resulting from past harvest and wildfire. This alternative would commercially thin and enhance shrub-steppe habitat on the most acres when compared to Alternatives 3 and 4. Treatment activities would reduce the amount and distribution of suitable nesting habitat and high quality foraging habitat within the analysis area to such a degree that goshawk may be less likely to use the analysis area after treatment. Available nesting habitat would largely be restricted to riparian areas and Dedicated Old Growth stands under this alternative. In the long term, this alternative would have the greatest improvement in terms of old growth (single stratum) development, resilience to fire, and would return the most acres in the dry upland forest PVG to a more appropriate structure and composition.

Alternative 3

Direct and Indirect Effects

This alternative would have virtually the same effects as those described under the *Alternative 2* section. This alternative would have slightly less impact on nesting habitat than Alternative 2; it would commercially thin and enhance shrub-steppe habitat on approximately 905 acres of suitable nesting habitat. This would equate to a 50% reduction in suitable nesting habitat in the short and mid term. In the long term, without further treatment of overstory vegetation, it is expected that stands would again be encroached by fire-intolerant conifers and stand densities and canopy closure would increase. As a result, some stands would transition back to a suitable nesting habitat condition in this time frame (see Silviculture Report). Under this alternative, the distribution and abundance of suitable nesting habitat would be greater in the long term than would be available under Alternative 2.

Under this alternative, foraging habitat quality would be impacted in the short and mid term on slightly fewer acres (10,823 acres) than under Alternative 2.

Cumulative Effects

The cumulative impacts of this alternative would be similar to those described under the *Common to All Action Alternatives* section. This alternative would result in a 50% reduction in suitable nesting habitat. Retention of larger patches of dense dry forest habitat would increase the likelihood of the Kahler analysis area providing goshawk nesting habitat and high quality foraging habitat of appropriate quantity and distribution to maintain occupancy and successful reproduction.

Alternative 4

Direct and Indirect Effects

This alternative would have the least impact on existing nesting habitat when compared to the other action alternatives. This alternative would result in a 37% reduction in suitable nesting habitat in the short and mid term. Under this alternative, the distribution and abundance of suitable nesting habitat would be the greatest in the short and long term than would be available under Alternatives 2 and 3. Under this alternative, there would be no felling or removal of trees larger than 21 inches dbh in treatment units. As a result, potential larger diameter nesting trees would not be impacted under this alternative.

Under this alternative, foraging habitat quality would be impacted in the short and mid term on fewer acres (9,817 acres) than Alternatives 2 and 3.

Cumulative Effects

The cumulative impacts of this alternative would be similar to those described under the *Common to All Action Alternatives* section. This alternative would result in a 37% reduction in suitable nesting habitat. Retention of larger patches of dense dry forest habitat and habitat in Class IV RHCAs would increase the likelihood of the Kahler analysis area providing goshawk nesting habitat and high quality foraging habitat of appropriate quantity and distribution to maintain occupancy and successful reproduction.

NEOTROPICAL MIGRATORY BIRDS

AFFECTED ENVIRONMENT

Neotropical migratory birds are those that breed in the U.S. and winter south of the border in Central and South America. Continental and local declines in population trends for migratory and resident landbirds have developed into an international concern. Habitat loss is considered the primary factor in the decline of some of these species. The Umatilla National Forest provides high quality habitat for resident and Neotropical bird species. According to the 2010 State of the Birds report (North American Bird Conservation Initiative 2010), "Short-term actions [to enhance Neotropical migratory birds] should focus on managing forests to increase resistance to change and promote resilience. Managers can help forests resist climate change by protecting forests with high ecological integrity such as National Forest roadless areas and by improving forest health and reducing undesirable (or extreme) effects of fires, insects, and diseases. We can increase the resilience of forests to accommodate gradual changes by emphasizing process rather than structure and composition, such as restoring natural fire regimes where possible, and restoring natural hydrology to maintain fragile riparian forests."

Partners in Flight (PIF) led an effort to complete a series of Bird Conservation Plans for the entire continental United States to address declining population trends in migratory landbirds. The Partners in Flight Bird Conservation Plans are used to address the requirements contained in Executive Order (EO) 13186 (January 10, 2001), *Responsibilities of Federal Agencies to Protect Migratory Birds*. Executive Order 13186 states that environmental analysis of Federal actions (through the NEPA) will evaluate the effects of actions and agency plans on migratory birds, and attempt to reduce unintentional take of migratory birds where it is expected to have a negative effect on migratory bird populations. *The Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington* (Altman 2000) was published by the Oregon-Washington Chapter of Partners in Flight in 2000. The Strategy uses a "priority habitats and focal species" approach. By managing for a group of focal species representative of important habitat components, many other species and elements of biodiversity would be conserved. Table W-35 displays focal species and associated priority habitats from the Altman (2000) publication.

Table W-35. Priority habitat features and focal species for habitats in the Northern Rocky Mountain Province as described in Altman (2000).

Habitat Type	Habitat Feature/Conservation Focus	Focal Species
Dry Forest	Large patches of old forest with large trees and snags	White-headed woodpecker
	Old forest with large trees & snags interspersed with grassy openings and dense thickets	Flammulated owl
	Open understory with regenerating pines	Chipping sparrow
	Patches of burned old forest	Lewis' woodpecker
Mesic Mixed Conifer	Large snags	Vaux's swift
	Overstory canopy closure	Townsend's warbler
	Structurally diverse; multi-layered	Varied thrush
	Dense shrub layer in the forest understory or forested openings	MacGillivray's warbler
	Edges and openings created by wildfire	Olive-sided flycatcher
Riparian Woodland	Large snags in riparian woodlands	Lewis' woodpecker
	Riparian woodland canopy foliage	Red-eyed vireo
	Riparian woodland understory vegetation	Veery
Riparian Shrub	Shrub density; willow/alder shrub patches	Willow flycatcher
Unique Habitats	Subalpine	Hermit thrush
	Montane Meadow	Upland sandpiper
	Steppe-shrubland	Vesper sparrow
	Aspen	Red-naped sapsucker
	Alpine	Gray-crowned rosy finch

Habitat types (defined in Altman 2000) present within the analysis area include Dry Forest (equivalent to the dry upland forest PVG), Mesic Mixed Conifer Forest (generally equivalent to the moist upland forest PVG), Aspen, and Steppe-Shrubland. Limited acres of Riparian Shrub habitat are also present along perennial streams within the analysis area.

Dry Forest Habitat

The majority (87%) of the analysis area is made up of dry upland forest habitats. The dry forest habitat type includes coniferous forest composed exclusively of ponderosa pine, or dry stands co-dominated by ponderosa pine and Douglas-fir or grand fir (Altman 2000). Bird species associated with dry forest have shown the greatest population declines and range retractions in the northern Rocky Mountain province (Altman 2000). In particular, bird species highly associated with snags and old-forest conditions have declined. These species include white-headed woodpecker, flammulated owl, white-breasted nuthatch, pygmy nuthatch, Williamson's sapsucker, and Lewis' woodpecker. Old forest, single-story ponderosa pine habitat has declined by 96 percent in the Blue Mountains ERUs (Ecological Reporting Units) of the Interior Columbia Basin, primarily due to timber harvest and fire suppression (Wisdom et al. 2000). Habitat restoration is the primary strategy for conservation of landbirds associated with this habitat type.

The dry upland forest habitat within the analysis area generally meets the dry forest habitat criteria provided by Altman (2000), with the exception of the size and spacing of old forest single-stratum (OFSS) habitat criteria. Old forest single stratum habitat is currently well below the Historical Range of Variability (HRV) in the dry upland PVG in the analysis area. All four of the dry forest focal species listed in the Altman (2000) report are believed to be present in the analysis area, either due to observation records, or assumptions that are based on the presence of potential habitat. The chipping sparrow is common on the District; the other species are uncommon. The Lewis' and white-headed woodpeckers were also analyzed as Sensitive species. Refer to the *Threatened, Endangered, Proposed, Candidate, and Sensitive Species* section for further discussion of these species.

Mesic Mixed Conifer Habitat

Mesic mixed conifer habitats are primarily cool Douglas-fir, grand fir, and larch sites; in some stands, lodgepole pine may also be present. Late successional stages have been commonly harvested with regeneration prescriptions such as clearcutting or shelterwood harvesting to reduce insect and disease damage. Bird species associated with late successional stages have been impacted by the loss of late-seral conditions and snags. The desired condition is a late successional, multi-layered forest with a diversity of structural elements. See Table W-38 for focal species and key habitat features in the mesic mixed conifer habitat type. Mesic mixed conifer habitat accounts for approximately 1% of the analysis area.

Steppe-Shrubland

Steppe-shrublands occur in a wide range of habitat types, including grassland, sagebrush, montane meadows, fallow fields, juniper-steppe, and dry open woodlands and openings in forested habitats (Altman 2000). Habitat criteria (objectives) for the steppe-shrubland habitat type include maintaining a mosaic of steppe and shrubland habitats with < 10 percent tree cover. Associated bird species include vesper sparrow, lark sparrow, Brewer's sparrow, and long-billed curlew. The majority of grassland habitats in the analysis area meet these objectives. These habitats are scattered throughout the analysis area, with the majority in the lowest elevations where dry grassland habitat is present. Grassland and non-forest habitat occurs on approximately 12% of the analysis area. Shrublands are present in the analysis area. Patches of sage brush, bitterbrush, and mountain mahogany are present in some areas, particularly in the southern portion of the analysis area. Conifers (juniper, ponderosa pine, and in some cases Douglas-fir) have encroached into historic shrubland habitat, reducing the quality, quantity (size), and connectivity of these patches.

Aspen

Aspen stands were once widespread throughout the Blue Mountains, however, a combination of factors including fire suppression, competition with invading shade-tolerant species, overgrazing (livestock and wild ungulates), and drought have contributed to their decline. Associated bird species include the red-naped sapsucker (focal species), Williamson's sapsucker, tree swallow, northern pygmy owl, western screech owl, and others.

Remnant aspen stands are present within the Kahler analysis area. In general, they are small in size (<1 acre), but several larger stands in excess of 5 acres are present. They are generally spatially discontinuous, have a deteriorating overstory, and have little regeneration. There are approximately 40 known aspen stands of varying size in the analysis area. Several of the known stands have been fenced to eliminate domestic and wild ungulate grazing; the majority of these fences are currently in poor condition. There are likely unmapped stands in the analysis area, as well.

ENVIRONMENTAL CONSEQUENCES/ANALYSIS OF EFFECTS

No Action

Direct and Indirect Effects

The current condition of habitat for land birds in the analysis area would not change in the short term or early mid-term. In the long term, dry forest habitats would continue to be invaded by shade tolerant tree species due to fire suppression. This would further restrict development of old forest single strata habitat; this habitat type would continue to be well below the HRV in the long term. Species requiring these habitats may be less abundant as a result. Mesic mixed conifer stands would also continue to develop multiple canopy layers and dense understories. Stress resulting from overstocking in upland forest stands would increase the susceptibility of these stands to insects and disease, which would in turn increase snags and downed fuel loadings and increase the risk of high severity fire. While mixed severity fire is anticipated to occur in dry upland forest stands, it is also expected that there would be larger patches of high severity impacts (due to higher flame lengths and resulting passive crown fire) than would have been expected historically. High severity burn effects have the potential to impact large green trees and snags. Fire would create edges and perches that would benefit some species (olive-sided flycatcher and Lewis' woodpecker), and encourage shrub regeneration. Species requiring high canopy closure and multiple canopy layers would be negatively impacted by a fire that creates larger patches of high overstory mortality; species like the black-backed woodpecker would benefit in the short term through improved nesting and foraging habitat. Aspen habitat quality would continue to decline as conifer encroachment continues. Existing aspen clones would shrink and ultimately die out without intervention and/or protection. Continued encroachment of conifers into steppe shrubland habitats would further reduce habitat quality in these stands by reducing vegetative diversity and altering structure and composition of shrublands. In the long term, the loss of shrubs would impact nesting and foraging habitat for a number of Neotropical migratory birds. Were wildfire to occur in grasslands and shrublands that have experienced conifer encroachment, there is a potential for more severe impacts to upland shrub habitat (particularly mountain mahogany) than would have been expected historically.

Common to All Action Alternatives

Direct and Indirect Effects

Proposed commercial thinning, non-commercial thinning, steppe-shrubland improvement thinning, temporary road construction (Alternatives 2 and 3 only), new road construction, mechanical activity fuels treatment (if necessary) and burning would have the same effects on Neotropical migratory bird habitat under each of the action alternatives; the extent (acres affected, miles of activities, etc.) would vary by alternative. Since potential habitat quality would be affected locally in proposed treatment units, within the underburn area, and along temporary roads, an increase in the acres (or miles) affected by these activities would have a greater impact on migratory birds and their habitat.

Planned activities in the Kahler analysis area (which represents about 2% of the Umatilla National Forest) may have short, mid, and long term effects at a local scale that may favor one or several bird species over another. Depending on the timing of treatment activities, there is a potential that mechanical treatment activities (commercial thinning, steppe shrubland thinning, and mechanical fuels treatment) may directly impact nests within treatment units. If ground conditions permit, these activities may occur in the spring when migratory birds are nesting. Nests may be crushed by machinery used in these units. It is not expected that these activities would result in impacts to population levels of migratory birds at either the analysis area (subwatershed) or Forest scale. If nests are lost, birds would likely re-nest in undisturbed habitats within the analysis area or elsewhere.

Commercial thinning in dry forest habitat would reduce stand densities, favor retention of large, old trees characteristic of dry sites (ponderosa pine, larch, Douglas-fir, and grand fir), and create small-scale heterogeneity by providing skips, gaps, and variable density patches within stands. All large, old trees (>150 years old) would be retained; a portion of Douglas-fir and grand fir that are greater than 21 inches dbh, but that are young (based on visual assessment) may be removed, felled and left, girdled, or topped to meet silviculture and wildlife goals. Treatment would move these stands towards a more characteristic structure and composition in the short and long term. Proposed treatments in dry forest habitats would promote the development of single-layered stands with large trees and snags and an open understory dominated by herbaceous cover, scattered shrub cover, and pine regeneration in the short and long term. The white-headed woodpecker and the flammulated owl would benefit in the short and long term through activities that would promote the development of large trees and snags and open canopies. Hazard and danger tree felling within treatment units and along roads would reduce existing snags to an unknown degree in the short and mid term. It is expected that the loss of large diameter snags along roads and in treatment units would be minimal due to the fact that only snags that pose a safety hazard would be felled. While all imminent danger trees along roads would be felled, those classified as having a “likely” failure potential may be retained for future wildlife habitat. A minor reduction in snags is not expected to impact habitat suitability or limit potential nesting strata for either the white-headed woodpecker or the flammulated owl. The chipping sparrow would also benefit from activities that create open understories and promote pine regeneration. Gaps would accentuate existing openings within units; natural regeneration and targeted planting of ponderosa pine in these areas would promote this priority habitat feature. The risk of high severity fire (and associated loss of large diameter trees and snags and old structure stands) would also be reduced, potentially reducing burned old forest habitats in dry upland forest (focal species: Lewis’ woodpecker). Dense untreated stands (Skips within units, class 1, 2, and 3 riparian habitats, and other untreated areas) within and outside the analysis area would continue to be at risk to high-severity wildfire (within the larger mixed fire severity regime) that would provide habitat for species like the Lewis’ woodpecker and black-backed woodpecker. Maintenance of skips composed of dense dry forest habitat within units and larger untreated areas across the landscape would be consistent with Management Considerations (*Habitat Conservation and Restoration*) contained in the white-headed woodpecker conservation strategy (Mellen-McLean et al. 2013). Mechanical activity fuels treatment prior to burning may occur where heavy accumulations of activity fuels pose a risk to residual vegetation. This activity would generally occur where vegetative disturbance has already occurred; additional short term impacts to habitat quality would occur should these activities occur in subsequent years. This activity would have the potential to impact nests if it occurs in the spring. Given the fact that only a portion of proposed units are expected to be directly impacted by mechanical fuels treatment activities, it is unlikely that population levels of migratory birds would be affected.

Mesic mixed conifer habitat would be affected on a portion of the affected area. Approximately 150 acres of thinning are proposed in moist upland forest stands that are intermingled with dry upland forest habitat; these stands would be considered to be equivalent to the Mesic Mixed Conifer habitat type. Overstory canopy closure and multi-layered conditions would be impacted by the proposed activities. It is unlikely that the Townsend’s warbler and the varied thrush (focal species for these habitat features) would use these stands following treatment. It is expected that treatment activities would have minor impacts on existing large snags present in these stands. A reduction in canopy closure would likely increase shrub cover in the understory in the short and mid-term in this habitat type. Stands with high canopy closure, a high proportion of grand fir and

Douglas-fir, and high dead wood densities are priority stands for untreated skips. It is likely that skips will be provided in these mesic mixed conifer stands, and that patches of untreated Mesic Mixed Conifer habitat would be available after implementation.

Commercial thinning would occur in approximately 10 acres of aspen lying within proposed treatment units. Competing conifers less than 21 inches dbh would be removed (with some retained for downed wood and girdled/topped for snags) in these stands; conifers >150 years old would be retained, regardless of size. Conifer felling and removal would reduce shading and competition for resources, improving growing conditions for the residual aspen and stimulating regeneration. Commercial thinning would not directly affect existing overstory aspen and aspen snags. Understory aspen sprouts may be impacted by mechanical equipment use, but they would recover in the years following vegetative treatment. In the mid and long term, these activities would improve habitat quality (regeneration of younger seral stages for replacement, large mature aspen, large aspen snags, and high mean canopy density) for the red-naped sapsucker, the focal species for the aspen habitat type (Altman 2000). Outside of treatment units, other aspen stands would be treated with non-mechanical methods as deemed necessary; as much as 20 acres of aspen outside of proposed units would be non-commercially thinned under all of the action alternatives. As was the case in those stands within proposed treatment units, these stands would be fenced to reduce browsing impacts associated with wild ungulates and livestock. This activity would allow for regeneration of the clone to occur, and reduce ground disturbance associated with browsing.

Under all of the action alternatives, there would be approximately 1,500 acres of ground-based mechanical thinning to improve steppe shrubland habitat. In the short term, the use of mechanical skidding equipment in a portion of these stands would cause disturbance to existing herbaceous vegetation and shrubs, and may impact nests if this activity occurs in the spring or early summer. The disturbance that would occur in individual units would vary greatly according the amount of encroaching conifers that are present. As larger, commercial-sized encroaching conifers are widely scattered through many of the affected acres, a relatively small proportion of unit acres would be impacted by mechanical skidding equipment. As a result, it is expected that only an occasional nest would be impacted by this activity, and that it would not impact population levels of shrub-steppe associated migratory birds. It is expected that vegetation would recover quickly; these impacts would persist for perhaps one to two growing seasons. Thinning/removal of encroaching conifers would improve growing conditions for shrub-steppe vegetation in the mid and long term.

New system road construction (0.4 miles under all action alternatives) and new temporary road construction (3 miles under Alternatives 2 and 3) would occur in dry upland forest habitat. Road building would constitute a removal of habitat, be it forested, shrub, grass, or lithosol from production along narrow corridors within this habitat type. The proposed new temporary roads generally follow existing openings, so impacts to overstory vegetation structure would be minimal. Existing temporary roads also follow existing openings or roadbeds. The miles of existing temporary road used would vary by alternative. Under both of these scenarios, clearing of understory vegetation and blading of the road surface may disturb habitat for ground and near-ground nesting birds within the road prism. Due to the narrow footprint of proposed new temporary roads (approximately 15 feet wide), impacts to habitat are expected to be minor. New and existing temporary roads would be decommissioned to varying degrees following their use. At a minimum, temporary roads would be seeded, hydrologically stabilized, and blocked to eliminate non-permitted use following implementation. Temporary roads would fill in with conifers and shrubs in the long term. Road construction also creates a situation in which hazard trees adjacent to the roads and must be removed. Because impacts to snags along these temporary road segments are expected to be minor, it is unlikely that species requiring large snags (white-headed woodpecker and flammulated owl) would be measurably impacted.

All of the action alternatives would burn approximately 31,000 acres within the analysis area. Landscape burning within the proposed underburn area would have short term impacts on nesting habitat for ground and near-ground nesting birds (focal species: chipping sparrow, vesper sparrow, varied thrush, and MacGillivray's warbler) in steppe-shrubland, dry forest, and mesic mixed conifer forest habitat types. The preferred time for landscape underburning would be the fall; however, spring burning may occur if weather and fuels conditions are appropriate. If spring burning occurs, attempts would be made to implement this activity prior to the peak of migratory bird breeding, approximately May 15. Spring burning may result in nest loss. The proposed underburn area would be broken into smaller burn blocks; adjacent burn blocks would not be burned in the same year to maintain well-distributed, undisturbed habitat for migratory bird species. Approximately 70% of individual burn blocks are expected to be blackened during burning; these unburned areas would include wet areas, areas with low fuel loading, and areas where grasses have not yet cured out. Grasses and shrubs would resprout in the year following burning due to the low intensity of burning. It is not expected that this activity would result in impacts to population levels of migratory birds at either the Forest or subwatershed scale. If nests are lost to this activity, ground and near-ground nesting Neotropical migratory birds would likely re-nest in adjacent habitat (unburned patches within burn blocks and areas outside burn blocks). This activity would also promote open understories and a more appropriate structure and composition on dry forest sites, improving habitat quality in the mid and long term for the chipping sparrow, flammulated owl, and white-headed woodpecker. Some snags potentially used for nesting and roosting by white-headed and Lewis' woodpeckers, and Vaux's swift may be lost to this activity. Losses of dead wood associated with landscape burning would be minimal due to the low intensity of these burns; impacts on habitat quality for these species are expected to be minor. Burning would have a neutral or positive impact on aspen stands that are currently present in the analysis area. Because underburns would be low intensity, there would be minimal impacts to overstory and understory aspen. Aspen clones will likely respond to burning by sending up additional vegetative shoots in the spring following burning.

Noncommercial thinning within and outside of commercially harvested stands has the potential to impact potential nesting habitat through direct removal of small diameter trees by hand or mechanical methods. Because clumps of untreated small diameter trees and individual small diameter trees (with appropriate spacing) would be retained within these units, the expected impacts to habitat for species that nest on or near the ground would be minor. Within harvest units, this activity would reduce cover and potentially nesting substrates, as described above. Mechanical non-commercial thinning (if it occurs) has the potential to directly impact ground nests. Given the fact that only a portion of these units would be expected to be impacted by mechanical non-commercial thinning activities, it is unlikely that population levels of migratory birds would be affected. This impact is expected to be minor and temporary; retained small diameter conifers, shrubs, and new conifer regeneration will provide cover and nesting substrate in the years following treatment.

Cumulative Effects

Past activities, actions, and events in the analysis area that may have affected Neotropical migratory bird habitat include timber harvest, road construction, wildfire (Wheeler Point), fire salvage (approx. 2,164 acres in the Wheeler Point burn), fire suppression, and livestock grazing. Timber harvest altered the structure and composition of forested stands in the analysis area. Generally, these activities converted older stands (including late and old structure habitat) to stand initiation, stem exclusion, and young forest structure stands. Harvest stimulated growth of understory shrubs, grasses, and small diameter conifers in affected stands, improving habitat for some Neotropical migratory birds requiring these features. Openings created by regeneration harvest and overstory removal treatments are still present on the landscape today. Road building generally resulted in a loss of potential migratory bird habitat, and fragmentation of habitat. Road construction also resulted in impacts to snags by increasing access for woodcutters and creating the need to mitigate danger trees along these routes. Wildfire had variable impacts on Neotropical migratory bird habitat; these events benefitted some species and were detrimental to others. Wildfire altered stand structure and composition and reduced stand complexity where it burned at high severity, reducing potential nesting habitat for those species requiring high canopy closure, multiple canopy layers, and stand complexity. The Wheeler Point Fire created high snag density patches in upland forest habitat, providing habitat for Lewis' woodpecker, olive-sided flycatcher, black-backed woodpecker, and other species that select for burned stands. Subsequent fire salvage greatly reduced potential habitat for post-fire adapted species like the Lewis' woodpecker; there is currently little burned habitat with high snag densities on NFS lands in the fire area. Fire suppression has resulted in reduced dry forest habitat quality due to the invasion of shade-tolerant vegetation and the development of multiple canopy layers. Historic livestock grazing had negative impacts on shrub and grassland communities, altering the structure and species composition in these habitats. This activity also removed nesting cover and structure. More recent livestock grazing (approximately 1960 to present) impacted dry forest habitat by decreasing ground cover and suppressing upland shrub communities. These activities have resulted in the current condition of migratory bird habitat in the analysis area.

Ongoing and reasonably foreseeable future activities, actions, and events that affect Neotropical migratory bird habitat include cattle grazing. Grazing seasonally reduces the height of grasses and suppresses upland shrub communities in some areas. Given the current stocking levels and the fact that standards are consistently being met in the allotments that lie within the Kahler Project area (Winlock, Yellow Jacket, and Collins Butte), it is unlikely that grazing is adversely impacting habitat or populations of ground nesting birds in the analysis area.

When the expected effects of these alternatives are combined with the residual and expected effects of past, present, and future activities, events, and actions, there would be a short term incremental reduction in nesting and hiding cover and increased disturbance on migratory birds, potentially causing nest abandonment and loss. Proposed treatment activities would begin to reverse structural and compositional habitat changes resulting from fire suppression and past harvest, by moving multi-strata old forest habitat toward a single-stratum structural condition in the dry upland forest PVG. Dry forest-associated birds would benefit in the mid and long term. Commercial thinning would also cumulatively reduce stand complexity and dense conifer stands used by some Neotropical migratory bird species. Understory vegetation potentially used for nesting would be impacted in the short term, but would be stimulated by these activities in the years following treatment. Landscape underburning would also have short term impacts on steppe-shrubland habitats and understory vegetation in forested habitat types; the cumulative impact would be minor due to the intensity, timing, and mosaic nature of this activity.

Alternative 2

Direct and Indirect Effects

This alternative would have similar effects to those described under the *Common to All Action Alternatives* section. Alternative 2 would commercially thin (with skips and gaps) the most acres (approximately 10,000 acres) when compared to the other action alternatives. For this reason, it would have the greatest short, mid, and long term impact on habitat and individual Neotropical migratory birds when compared to the other action alternatives. Disturbance to potential nesting habitat, potential nest loss (should mechanical treatment occur in the spring), and snag reductions (through hazard/danger tree felling and burning) would be the greatest under this alternative. This alternative would also have the greatest long term benefit on open dry forest stands (see *Late and Old Structure* section); activities that restore or move stands toward an open, old forest structural condition would benefit the white-headed woodpecker, Lewis' woodpecker, and flammulated owl (focal species for this habitat type and features).

Under this alternative, the most miles of existing temporary road (6.9 miles) and closed system road (58.2 miles) would be used to implement the proposed activities. As a result, the immediate and long term impacts associated with road use and construction would be greatest under this alternative.

Cumulative Effects

The cumulative impacts of this alternative would be similar to those described under the *Common to All Action Alternatives* section. When the residual and expected effects of past, present, and reasonably foreseeable future activities are combined with the expected effects of this alternative, Alternative 2 would have the greatest incremental reduction in nesting and hiding cover and cause the most disturbance on migratory birds and their habitat in the short term. This is due to the fact that this alternative would treat vegetation (through mechanical means) on the most acres when compared to Alternatives 3 and 4. This alternative would also have the greatest positive cumulative impact on dry forest late and old structure habitat (single-stratum) and associated Neotropical migratory birds by promoting its maintenance or restoration on more acres than Alternatives 3 and 4.

Alternative 3

Direct and Indirect Effects

This alternative would have similar effects to those described under the *Common to All Action Alternatives* section. This alternative would commercially thin slightly fewer acres (approximately 9,170 acres) and require less existing temporary road use (5.4 miles) and closed road use (53.5 miles) than Alternative 2. As a result, there would be less short and mid term impacts on Neotropical migratory bird habitat. This alternative would non-commercially thin more acres (845 acres, +155 acres) than Alternative 2.

Cumulative Effects

The cumulative impacts of this alternative would be similar to those described under the *Common to All Action Alternatives* section. When the residual and expected effects of past, present, and reasonably foreseeable future activities are combined with the expected effects of this alternative, there would be an incremental reduction in nesting and hiding cover and increased disturbance on migratory birds and their habitat in the short term. This reduction would be less than what would occur under Alternative 2 due to a reduction in the number of acres that would be mechanically treated. This alternative would contribute to reversing past losses of open canopy old structure habitat in the dry upland forest PVG to a slightly lower degree than Alternative 2.

Alternative 4

Direct and Indirect Effects

This alternative would have similar effects to those described under the *Common to All Action Alternatives* section. This alternative would commercially thin and enhance shrub-steppe habitat on the fewest acres (approximately 8,230 acres) and require less existing temporary road use (5.4 miles) and closed road use (51.5 miles) than Alternatives 2 and 3. There would also be no new temporary road construction under this alternative. As a result, this alternative would have the least short and mid term impacts on Neotropical migratory bird habitat.

Cumulative Effects

The cumulative impacts of this alternative would be similar to those described under the *Common to All Action Alternatives* section. When the residual and expected effects of past, present, and reasonably foreseeable future activities are combined with the expected effects of this alternative, there would be an incremental reduction in nesting and hiding cover and increased disturbance on migratory birds and their habitat in the short term. This reduction would be less than what would occur under Alternatives 2 and 3 due to a reduction in the number of acres that would be mechanically treated, the elimination of new temporary road construction, and a reduction in the miles of closed roads used to access treatment units. This alternative would contribute to reversing past losses of open canopy old structure habitat in the dry upland forest PVG to a lesser degree than Alternatives 2 and 3.

SUMMARY OF IMPACTS TO PROPOSED, ENDANGERED, THREATENED, AND CANDIDATE WILDLIFE AND R6 SENSITIVE WILDLIFE SPECIES AND HABITAT

BIOLOGICAL EVALUATION

The species listed below are those Federally ESA listed and Region 6 Sensitive Species that were analyzed for the Kahler Dry Forest Restoration Project. Impacts were not evaluated for the Canada lynx, North American wolverine, painted turtle, Rocky Mountain tailed frog, upland sandpiper, peregrine falcon, Townsend's big-eared bat, Yuma skipper, fir pinwheel, and sage grouse because they are not present in the analysis area, have no suitable or potential habitat within the analysis area, or both. For this reason, the proposed project would have no impact on these Region 6 Sensitive Species and no effect on the Threatened Canada lynx. The table below summarizes the determinations made for those species analyzed fully in this report.

Table W-32. Summary of Determinations

Species	**Designation**	**Determination**		
		Alt 2 (Proposed Action)	**Alt 3**	**Alt 4**
Columbia spotted frog *Rana luteiventris*	Sensitive	NI	NI	NI
Bald eagle Haliaeetus leucocephalus	Sensitive	MIIH	MIIH	MIIH
White-headed woodpecker *Picoides albolarvatus*	Sensitive	MIIH	MIIH	MIIH
Lewis' woodpecker *Melanerpes lewis*	Sensitive	MIIH	MIIH	MIIH
Gray wolf *Canis lupus*	Endangered	NE	NE	NE
Johnson's hairstreak butterfly *Callophrys johnsoni*	Sensitive	MIIH	MIIH	MIIH
Intermountain sulphur butterfly *Colias christina pseudochristina*	Sensitive	MIIH	MIIH	MIIH

NE - No effect on a proposed or listed species or critical habitat
NLAA - May affect, but not likely to adversely affect a listed species or critical habitat
LAA - May affect and likely to adversely affect a listed species or critical habitat
NI - No Impact to R6 sensitive species individuals, populations, or their habitat
MIIH - May Impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.
WI - Will impact individuals or habitat with a consequence that the action will contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Literature Cited

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Appendix N
Supporting Forest Vegetation Report

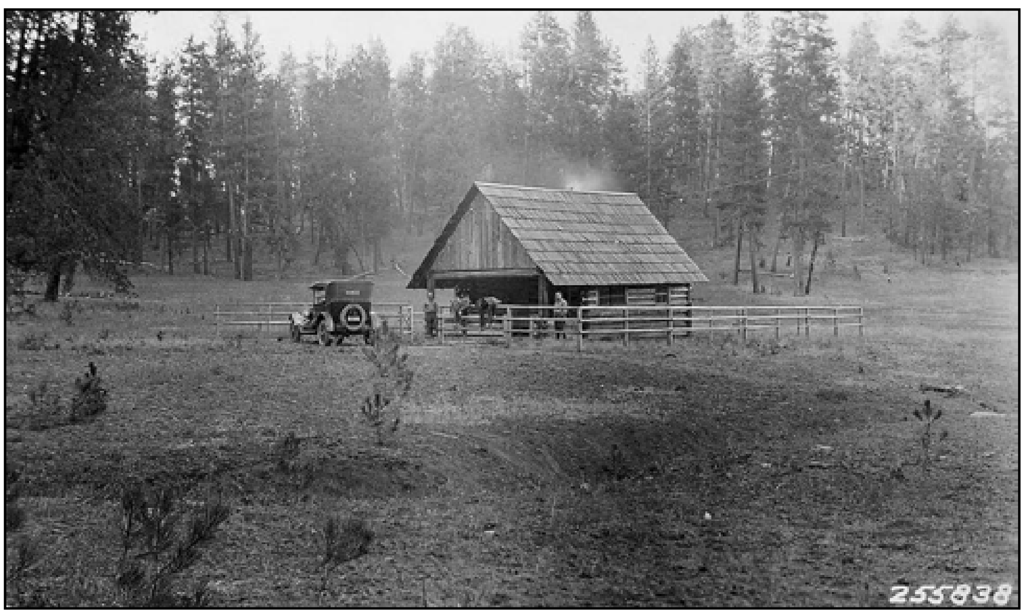
Kahler Dry Forest Restoration Project

Forest Vegetation Report

Prepared by:
David C. Powell
Forest Silviculturist
(retired 1/2/2015; this version completed as volunteer)

Heppner Ranger District
Umatilla National Forest

May 5, 2015



BULL PRAIRIE RANGER STATION (BY WALT L. DUTTON; APRIL 14, 1931)
[LOCATED A FEW MILES EAST OF KAHLER PLANNING AREA]

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Introduction

Upland forests in the Kahler area need to be restored. Relatively recent damage from defoliating insects (spruce budworm and tussock moth), uncharacteristic wildfire effects associated with the 1996 Wheeler Point fire, and dense forests containing low vigor trees are symptoms of impaired forest health and deteriorating ecosystem integrity. The causes of these symptoms are related to historical changes in species composition, forest structure, and stand density. If composition, structure, and density are not moved back within their historical ranges of variation, then insect and fire problems will continue into the future.

Specifically, there is a need to address the following conditions in the Kahler planning area:

- Dry-forest sites currently support too much of the Douglas-fir forest cover type, and too little of the western larch forest cover type – an historical range of variation (HRV) analysis found that Douglas-fir is over-represented, or too abundant, and western larch is under-represented.
- Dry-forest sites currently support too much of the stem exclusion (SE) and understory reinitiation (UR) structural stages, and too little of the old forest single stratum structural (OFSS) stage – HRV analysis found that SE and UR are over-represented, and OFSS is under-represented.
- Dry-forest sites currently support too much of the high stand density class, and too little of the low density class – HRV analysis found that high stand density is over-represented, and low stand density is under-represented. High stand density is a management concern because it contributes to insect and disease outbreaks, uncharacteristic levels of crown fire, and other disturbance processes.

This specialist report describes the environmental consequences of modifying three vegetation components in the Kahler planning area: species composition, forest structure, and stand density. Vegetation modifications would be accomplished by implementing the following treatment activities, either as direct or connected actions: upland forest commercial thinning, juniper thinning and shrub-steppe enhancement, prescribed fire (underburning in forest stands), riparian-area thinning, danger-tree removal, upland forest noncommercial thinning, aspen restoration, and reforestation.

This report also includes the rationale for amending the wildlife portion of the Eastside Screens amendment to the Forest Plan (specifically item 6 d, Scenario A); Scenario A refers to situations where one or both of the late-old structure (LOS) components are below HRV. The amendment authorizes two actions:

1) Some of the large, but young, Douglas-fir and grand fir trees that are ≥ 21 inches in ‘diameter at breast height’ (dbh), but less than 150 years in ‘age at breast height’ (abh), will be removed from any of the structural stages being treated, ***except for units classified as the old forest single stratum structural stage*** (OFSS; this stage is called “single stratum with large trees” in the Eastside Screens).
2) Thinning treatments will occur in a structural stage called OFSS, which is below HRV; thinnings will only remove trees < 21 inches dbh, and there will be no net loss of late-old structure (LOS) following the treatment (e.g., the units classify as OFSS before treatment, and they will classify as OFSS after treatment).

Concerns about existing forest vegetation conditions, and how they apparently depart from historical conditions traditionally believed to represent low susceptibility to wildfire, insects, and diseases, were raised during the scoping phase of the Kahler Dry Forest Restoration Project environmental analysis process. The vegetation analyses presented in this report examine whether, and to what extent, existing conditions depart from historical conditions for the Kahler planning area, so they support the Kahler project’s purpose and need, and its associated proposed action.

Analyses described in this report pertain to National Forest System lands occurring in the following subwatersheds: Alder Creek (170702040108), Lower Kahler Creek (170702040104), Upper Kahler Creek (170702040103), Haystack Creek (170702040105), and Bologna Canyon (170702040101). This planning area contains approximately 32,840 acres.

Note: Acreage figures in this specialist report are approximate and are rounded to the nearest 10 acres. Therefore, acreage totals may differ by 10 acres, from one column to another in tables, due to rounding.

Proposed silvicultural activities

Forest vegetation analyses for the Kahler Dry Forest Restoration Project identified a need to modify species composition, forest structure, and stand density to move them toward their historical ranges of variation. The Kahler project proposes to implement silvicultural activities on app. 12,220 acres (alternative 2, the proposed action) or app. 11,540 acres (alternative 3) to complete these vegetation modifications.

Silvicultural activities are described below by using a narrative (one narrative section for each activity); acres of each activity proposed for implementation, by alternative, along with objectives and specifications for each activity, are summarized in table 1. Appendix 1 provides activities by treatment unit.

Table 1: Silvicultural activities included in the Kahler Dry Forest Restoration Project

Silvicultural Activity	Alternative 2 (Acres)	Alternative 3 (Acres)	Activity Objectives and Specifications
Upland forest commercial thinning	10,000	9,170	Variable-density thinning (VDT), or thinning by using the individuals, clumps, and openings approach (ICO), also with skips and gaps, will be used to adjust species composition, forest structure, and stand density.
Upland forest noncommercial thinning (NCT) outside of harvest units	730	880	Noncommercial thinning is applied in situations where trees to be cut do not have commercial value; NCT is also used to adjust species composition, forest structure, and stand density for treated stands.
Upland forest NCT inside harvest units	5,000*	4,580*	It is assumed that 50% of the commercial thinning acreage will also require NCT to address stand density issues identified during the HRV analyses.
Juniper thinning and shrub-steppe enhancement	1,500	1,500	Western juniper invaded shrublands historically dominated by mountain mahogany or bitterbrush, and it invaded dry-forest sites historically dominated by ponderosa pine. Thinning will reduce juniper abundance.
Dry forest RHCA thinning	680*	660*	Intermittent channels on dry-forest sites (class IV riparian habitat conservation areas; RHCAs) will be treated by using VDT (560 acres for alt. 2; 540 for alt. 3), NCT (50 acres), and shrub-steppe enhancement (70 acres).
Aspen restoration	10*	10*	Aspen is a keystone ecosystem type, but it has a limited distribution in the Kahler planning area. Conifer removal, thinning, fencing, and other treatments will be used to help restore quaking aspen ecosystems.
Reforestation in VDT gaps	1,000*	920*	Reforestation will be used to help restore early-seral species (primarily ponderosa pine and western larch) in gaps created by using VDT.
Reforestation in Wheeler Point fire	5,000	5,000	Microsite planting will occur on up to 5,000 acres of the Wheeler Point fire where competition from shrubs (primarily snowbrush ceanothus) is low enough to allow this approach to be successful.
Prescribed fire (Underburning in treated stands)	7,000*	6,420*	Low-severity fire is a keystone process for dry forests, so fire will be restored to its proper function as soon as possible; acreage values assume that 70% of CT treatment area will be underburned.

* These acreages are double-counted because they represent additional treatments applied to acreage already affected by another activity (such as noncommercial thinning occurring after the upland forest commercial thinning activity has been completed). Acreages without asterisks are associated with the primary activities; acreages with asterisks are secondary or follow-up treatments occurring after a primary activity has been completed.

Upland Forest Commercial Thinning

The Kahler project proposes to use variable-density thinning with skips and gaps to reduce stand density, shift species composition, and promote old forest structure. Approximately 10-15% of each unit will remain untreated in skips that are half an acre or larger in size, and approximately 10-15% of each unit will become open gaps that are generally ½ to 2 acres in size. Between skips and gaps, the matrix area will be thinned to a variable density with minimum amounts of residual basal area varying with a unit's plant association (at least 25-60 ft^2/acre of basal area will be retained after thinning; see tables 16 and 48).

There will be an option to remove select young (< 150 years abh) grand fir and Douglas-fir trees that are 21 inches or greater dbh (as determined by using Van Pelt 2008 or tree coring) and interacting with a desirable tree ('interaction' is defined as occurring within a 2-dripline distance of a desirable tree). No other trees that are > 21" dbh will be removed, other than danger trees along transportation routes and other trees posing a risk to public health and safety.

Tree species preference is for retention of ponderosa pine and western larch. This preference is designed primarily to maintain low or moderate susceptibility to defoliating insects. Western spruce budworm and Douglas-fir tussock moth, two defoliating insects that feed in mixed-conifer forest, caused extensive damage in or near the Kahler planning area in the recent past (Scott 2002, Sheehan 1996, USDA Forest Service 2004a). Figure 7, shown later in this report, provides a 14-year chronology of spruce budworm defoliation for the Kahler planning area. It shows that at several points during the 1980-1992 budworm outbreak, almost the entire Kahler planning area experienced some level of budworm defoliation.

Douglas-fir tussock-moth has been active in the Kahler area as well, with the most recent tussock-moth outbreak occurring in the late 1990s and early 2000s in the Bologna Canyon area (Scott 2002) (the Bologna Canyon subwatershed is contained entirely within the Kahler planning area). This tussock-moth outbreak was severe enough to result in a Bologna Basin Salvage Sale project (USDA Forest Service 2004a), when some of the dead and dying trees were removed and utilized for wood products.

Species preference objectives relating to defoliator resistance involve maintaining a forest composition with no more than 30% of late-seral or climax tree species providing budworm or tussock-moth habitat (Carlson and Wulf 1989, Carlson et al. 1983) – for tree species found in the Kahler area, Douglas-fir, Engelmann spruce, and grand fir provide habitat for budworm and tussock moth. The other 70% of forest composition should consist of non-host species – for Kahler, the non-host species consist of western larch, lodgepole pine, ponderosa pine, quaking aspen, and western juniper.

Note: Recent reconnaissance suggests that Douglas-fir tussock moth or western spruce budworm may be active in the Kahler area once again (Spiegel 2013) – sparse and thinning crowns in Douglas-fir trees indicate that insect-caused defoliation may be occurring now, or may have occurred in the very recent past.

Diseased trees, and those with severe infestations of a parasite called dwarf mistletoe, will be identified for removal when doing so meets dry-forest restoration objectives described in the Purpose and Need section. In some areas, thinning prescriptions will specifically retain some of the decadent, broken-topped, or malformed trees when their retention contributes to wildlife objectives.

Although dwarf mistletoe has always been a component of interior Northwest forest ecosystems, its current abundance and advanced infection levels threaten development and persistence of large trees on many dry-forest sites in the Kahler planning area. Two common outcomes for trees infected with dwarf mistletoe are as follows: (1) trees never grow and develop to a size the species is capable of, such as trees with a diameter of 21 inches or greater when trees of this size are desired to meet old forest objectives; and (2) trees will be killed when wildfire (or prescribed fire under certain circumstances) moves through a stand because long dwarf-mistletoe brooms function as ladder fuel (Schmitt and Spiegel 2012).

Trees may be removed from treatment units by using ground-based, cable, or helicopter logging systems, separately or in combination, depending on slope gradient, soils, and other site characteristics. Snag and downed wood standards from the Eastside Screens (USDA Forest Service 1995) will be followed when implementing silvicultural activities. Thinning, and removal when possible, of western juniper from 7 inches to 21 inches dbh may occur in timber harvest units, including Class IV riparian areas, when it is evident that juniper exceeds historical levels. Reducing the amount of western juniper is expected to maintain or enhance the quality of upland forest habitat, to improve the diversity and productivity of riparian plant communities, and to increase water availability for native vegetation (Grant et al. 2013).

Variable-density thinning will be used to retain, promote, or enhance the spatial heterogeneity associated with tree clumps, skips, and gaps (fig. 1; Larson et al. 2012). To model the effects of this treatment on forest stands, the Forest Vegetation Simulator (FVS) (Dixon 2002) was used. FVS allows modeling of potential treatment effects on forest vegetation, with quantitative measurements of density, structure, and composition. Several proposed units were modeled in FVS by examining alternative thinning approaches.

Two thinning approaches are proposed for stands where trees to be removed have commercial value: variable-density thinning (VDT) with skips and gaps; and variable-density thinning by using the individuals, clumps, and openings approach (ICO), also with skips and gaps. Both approaches are designed to create spatial heterogeneity at a sub-stand scale (Larson et al. 2012), and to restore dry-forest structure and ecological function associated with the presettlement era (presettlement composition, structure, and density for dry-forest ecosystems is examined in Powell 2014a).

The ICO approach is described by Churchill et al. (2013a) and Churchill et al. (2013b). The VDT approach predates the ICO method, but it still incorporates the dry forest restoration principles described by Franklin and others (Franklin et al. 2007, 2013).

Actual differences between the VDT and ICO approaches are not expected to be significant, but they are being implemented in such a way as to monitor whether differences will occur, and what the characteristics and magnitude of any differences might be. Both of the variable-density thinning approaches will:

1) Retain legacy trees.
2) Establish or enhance openings (gaps) of various sizes within treatment units.
3) Retain or expand clumps and skips (unthinned areas) within treatment units.

The ICO approach uses a trees-per-acre goal for developing clump quotas, whereas the variable-density thinning uses a basal area range across the unit in order to reach a desired post-treatment objective. Under both treatment approaches, retention clumps of different sizes are prescribed in proportions approximating historical reference conditions.

Upland-forest thinning will be used to help create an open, single-layered canopy structure amenable to reintroduction of low-severity surface fire, a keystone disturbance process providing tree thinning and nutrient cycling benefits. A high priority is to apply upland-forest thinning on areas within the frequent surface-fire regime (Fire Regime I), which will make them more resistant to uncharacteristically severe wildfire (see fig. 9) by reducing surface and ladder fuels, and by raising canopy base height (Arno et al. 1995, Brown et al. 2004, Mutch et al. 1993, Pollet and Omi 2002, Scott 1998, Stephens 1998).

Thinning is proposed for stands assigned to the moderate or high stand density classes. Tables in Powell (1999, 2013a) provide stand density recommendations by tree species and potential vegetation category (plant association, plant association group, potential vegetation group). Post-treatment stand density objectives for either VDT or ICO thinning are based on suggested stocking levels developed for tree species and plant associations of the Blue Mountains ecoregion (Cochran et al. 1994, Powell 1999). Stand density objectives for Kahler project are presented in a Suggested Stocking Levels section later in this report.

Figure 1 – Small clump of older ponderosa pine, located in the south portion of treatment unit 19 in the Kahler planning area (photo by D.C. Powell). An objective of variable-density thinning, including the Individuals, Clumps, and Openings approach (Churchill et al. 2013), is to maintain or reestablish as much of this groupy or clumpy structure as possible (Larson et al. 2012). [Note that a prescription was prepared for unit 19 (then called unit 101), and it was used for silvicultural certification by Carrie Spradlin (Spradlin 2011).]

Thinning Approach 1: Variable Density Thinning With Skips and Gaps

Variable density thinning (VDT) with skips and gaps is a type of thinning where trees having commercial value are removed to reduce stand density, alter forest structure, and improve growth of remaining trees. Skips are areas where no harvest occurs and no machinery enters; gaps are areas cleared of nearly all live trees. VDT with skips and gaps uses concepts and principles from ecological forestry (Franklin et al. 2007), and it is also informed by research examining spatial heterogeneity associated with historical stand structure on dry-forest sites (Franklin et al. 2013, Harrod et al. 1999, Larson and Churchill 2012, Larson et al. 2012, Van Pelt 2008).

VDT with skips and gaps produces spatially complex stands containing areas for early-seral species recruitment (gaps), retention patches consisting of late-seral species or high density conditions (skips), and a clumpy or groupy structure historically typifying dry forests (matrix areas between skips and gaps).

When prescribed fire is applied following thinning treatments, direct ignition will not occur within skips, but fire will be allowed to back into, or move through, the skips, producing inherently variable fire effects that will be acceptable from both a forest vegetation and wildlife habitat perspective.

Additional discussion about the historical structure of dry forests, and the scale at which it was developed and maintained, is provided in a white paper incorporated by reference (Powell 2014a; see page 81 and pages 98-100 specifically in that source).

Thinning Approach 2: Variable Density Thinning Using Individuals, Clumps, and Openings (ICO)

Variable-density thinning based on historical spatial patterning (referred to as the Individual, Clumps, and Openings, or ICO, approach) is a thinning method utilizing historical reference conditions to influence the treatment specifications (prescription and marking guide) for contemporary stands (Churchill et al. 2013b; Franklin at al. 2013). The ICO approach incorporates ecologically important structures and patterns into treatment prescriptions for achieving desired future conditions related to species composition, forest resilience, and wildlife habitat, while also providing some level of wood products.

Just like VDT, the ICO approach builds on ecological forestry concepts described by Franklin et al. (2007), and it is also informed by research examining the spatial heterogeneity associated with historical stand structure on dry-forest sites (Harrod et al. 1999, Larson and Churchill 2012, Larson et al. 2012).

The ICO method provides a quantitative way to develop or enhance heterogeneous spatial patterns by allocating treatment specifications by clump size (including individual trees outside of clumps). In addition to providing a heterogeneous clump distribution, the ICO method incorporates skips and gaps comprising 10-15% each of a treatment unit.

Suggested stocking levels for Kahler project (page 81) pertain to 'matrix' areas outside of skips and gaps.

Upland Forest Noncommercial Thinning

Noncommercial thinning (NCT) involves cutting small, unmerchantable trees to reduce stand density, and to improve growth and vigor of trees retained after thinning. Variable-density thinning will also be used for noncommercial treatments to induce spatial heterogeneity where it is lacking, or to maintain or enhance it when already present.

Noncommercial thinning will cut conifer seedlings, saplings, and small poles, generally up to 7 inches dbh, and western juniper trees less than 12 inches dbh, to help meet forest vegetation needs identified in the Kahler project's purpose and need, including tree vigor improvement for insect and disease resistance, restoring and maintaining a sustainable species composition, increasing forage for native and domestic ungulates, and addressing fire hazard by reducing ladder fuels.

For noncommercial thinning treatments, tree species will be retained in this order of preference: ponderosa pine, western larch, Douglas-fir, Engelmann spruce, grand fir, lodgepole pine, and western juniper.

Noncommercial thinning units will be treated by hand using chainsaws, or treated by using mechanical equipment such as masticators. Stands will meet or exceed minimum stocking levels after treatment (see table 16 later in this document), and no reforestation will be required following noncommercial thinning treatments. Created slash will either be lopped and scattered to within 18 inches of the ground surface, mechanically treated (grapple piling, chipping, or slash-busting), or hand piled and burned, depending on post-treatment fuel loads and site characteristics or limitations.

Trees being cut in the noncommercial thinning activity may have commercial value depending on tree-size limitations associated with the harvest system or processing equipment being used. Generally, trees 7 inches dbh or smaller are not considered to have commercial value, although small-diameter trees may have value for chips, hog fuel, and other non-sawtimber products, depending on market conditions and a treatment unit's proximity to a transportation system and wood-product markets.

Markets for small-diameter trees are unreliable, so it is uncertain whether trees below 7 inches dbh will be removed during the commercial treatments. Due to uncertainty about market conditions, the need to cut trees less than 7 inches in diameter (less than 12 inches in diameter for western juniper) will be analyzed as a noncommercial treatment for this environmental assessment process.

Reforestation

In commercial-thinning units with a low proportion of early-seral tree species, primarily because they were removed during historical timber harvest operations (Powell 2014a), reforestation with ponderosa pine and/or western larch (e.g., out-planting of pine or larch seedlings) may occur after harvest and burning activities have been completed.

For thinning units, reforestation will be prescribed for larger gaps (openings of 1 to 2 acres) because they provide enough sunlight and growing space for pine and larch establishment, for areas where seed quantities for ponderosa pine or western larch are expected to be low due to a lack of suitable seed trees, and for other situations where artificial regeneration would contribute to establishment of a future species composition compatible with defoliator resistance and other desired conditions for the Kahler planning area.

Slightly more than 5,000 acres of non-stocked condition has been identified in the 1996 Wheeler Point wildfire area; these areas now support sparse tree regeneration and nonforest communities dominated by shrubs (particularly snowbrush ceanothus, *Ceanothus velutinus*) and graminoids. Snowbrush ceanothus has long been recognized as a conifer regeneration inhibitor (Booth 1963, Wahlenberg 1930).

Many portions of the fire area have been planted with conifer seedlings – some portions more than once. Reforestation results in the Wheeler Point fire have been inconsistent (fig. 2). Future reforestation efforts in the fire area will be targeted toward microsite planting by trying to establish conifer seedlings on areas lacking intense competition from competing vegetation such as snowbrush ceanothus and graminoids.

The reforestation activity involves clearing (scalping) a small area with a hand tool, using a hand tool or powered soil auger to dig a small hole, placing a tree or shrub seedling into the hole, filling the hole with soil while avoiding injury to the seedling roots, and carefully firming soil around the roots.

Scalping involves using a hand tool to clear non-tree vegetation and woody debris from a small area in which a tree seedling is to be planted. It provides fair control of competing vegetation during the first growing season, particularly for grasses and sedges whose root systems are not yet well established. When used on sites without severe competing vegetation problems, hand scalping is typically implemented by clearing 12- or 18-inch square areas (a seedling is planted in the middle of the cleared area).

Hand scalping, a site preparation silvicultural activity, will be completed within two years after regeneration timber cutting has occurred, as specified in the Forest-wide standards and guidelines section of the Forest Plan (item number 6 on page 4-70 in the Forest Plan). [But note that no regeneration cutting is proposed for the Kahler project.]

Prescribed Fire (Underburning in Forest Stands)

Although sometimes not considered to be a silvicultural activity, underburning is a key maintenance practice for sustaining stand density, forest structure, and species composition following any of the thinning treatments. The Kahler project proposes to implement underburning across virtually the entire planning area (Marshall 2014).

For purposes of this analysis, underburning is assumed to occur about every 10-20 years, commencing after thinning activities are completed (for timber sale units, both commercial and noncommercial thinning must be completed before prescribed fire will be implemented). In the near term (next 50 years), prescribed fire would occur about every 10 years; for the far term (> 50 years), prescribed fire would occur every 20 years because climate change is expected to reduce fuel accumulation (Diggins et al. 2010).

The fuels specialist report for the Kahler Dry Forest Restoration Project (Marshall 2014) provides detailed information and specifications about application of prescribed fire.

Figure 2 – Reforestation situation for the Wheeler Point wildfire area (photos by D.C. Powell). Much of the Wheeler Point fire has been planted at least once (some portions multiple times). Tree planting has been successful in some instances (top), but more than 5,000 acres of non-stocked condition exists within the fire area (bottom), and it will continue to receive reforestation treatments to augment the sparse stocking levels. Much of the background vegetation (bottom) is snowbrush ceanothus, a conifer-inhibiting shrub (Wahlenberg 1930).

Juniper Thinning and Shrub-Steppe Enhancement

Several portions of the Kahler planning area have abundant western juniper regeneration (small and relatively young juniper trees) that survived, and then thrived, after anthropogenic wildfire suppression, an action preventing fire from fulfilling its natural role as a tree-thinning process (Azuma et al. 2005, Miller et al. 2005). Review of 1939 aerial photography suggests that many areas occupied by small juniper trees were grassland or shrubland historically; these areas subsequently transitioned to juniper woodlands.

Some shrublands in the planning area were historically dominated by bitterbrush (*Purshia tridentata*) or mountain mahogany (*Cercocarpus ledifolius*), two species important as browse species for native ungulates. Remnant bitterbrush and mountain mahogany are reduced in abundance and vigor due to shading from invading conifers (fig. 3), particularly western juniper, and from ungulate browsing impacts. Juniper thinning will remove young, commercially useful juniper trees, while leaving older junipers.

Western juniper also invaded upland-forest sites historically occupied by open stands of ponderosa pine. When the historical fire regime was functioning properly and low-severity fire occurred every 5 to 20 years, most western juniper trees were killed because the interval between fires was too short to allow this slow-growing species to become fire-resistant. Conversely, dominant ponderosa pine grew fast enough to escape fire's impact, eventually forming an open, resilient, park-like structure. Now that frequent fire has been suppressed, juniper has moved onto these sites and become established beneath the pines, and it now limits regeneration of a keystone plant species for dry-forest environments – ponderosa pine.

[Ponderosa pine is considered to be a keystone species *for dry-forest sites* because its presence affects survival and abundance of many other species, including wildlife such as white-headed woodpecker and flammulated owl (Mellen-McLean et al. 2013).]

Treating western juniper in the Kahler planning area is encouraged by a Memorandum of Understanding, approved in late summer 2014, concerning western juniper and economic opportunity (BLM 2014).

Aspen Restoration

Within the Kahler planning area, scattered and disjunct aspen stands are found in both forested and non-forested environments (fig. 4). The proposed action contributes to aspen restoration by implementing a suite of management practices in aspen stands, including the following activities: thinning, underburning, and fencing (protection). Aspen restoration thinning will involve removal of competing conifers up to 150 years old and as much as 100 feet from the farthest aspen sucker. Aspen underburning will occur in conjunction with any associated forest underburning taking place in the same general area.

Protection of existing aspen clones will involve repair and maintenance of existing fences, along with fence construction for currently unfenced clones; both activities are highly dependent on partnership financing and involvement from sources such as Rocky Mountain Elk Foundation and Blue Mountains Elk Initiative.

Dry Forest RHCA Thinning

Dry-forest stands within the Kahler planning area often include intermittent stream channels; these channels may contain water during a short period in early spring during the snowmelt period (fig. 5). Riparian habitat conservation areas (RHCAs) are stream and wetland protection zones delineated for the protection of riparian-dependent resources. RHCAs typically include riparian vegetation corridors; buffers or equal-width zones established along perennial or intermittent stream channels, and adjacent to lakes, springs, or seeps; and other wetland ecosystems where riparian function and associated ecological processes are crucial to maintenance of an area's water quality, sediment regime, large woody debris production, and nutrient delivery systems.

Figure 3 – Western juniper expansion on a dry-forest site, likely as a result of fire exclusion (Kahler planning area; photo by D.C. Powell). This image portrays a dry forest example of the ponderosa pine/bitterbrush/Ross' sedge (PIPO/PUTR/CARO) plant association (Johnson and Clausnitzer 1992). Juniper is occasionally associated with late-seral communities in this plant association, but it typically occurs at low canopy coverage (2% mean cover for the 7 PIPO/PUTR/CARO samples included in Johnson and Clausnitzer 1992), and it is not found in every stand (juniper occurred in 42% of the samples). The amount of juniper shown here is greater than what was recorded by Johnson and Clausnitzer (1992, appendix C) in their late-seral sample stands. Juniper has increased in areal extent from historical levels – the interior Columbia Basin ecosystem management project reported increases of 243% for the juniper/sagebrush cover type in the Blue Mountains ecological reporting unit (Quigley and Arbelbide 1997, p. 676). Although much of this increase involves juniper expansion into rangelands, juniper also invaded dry-forest sites. Manifold increases in western juniper abundance have been reported for many studies examining eastern Oregon vegetation conditions (Azuma et al. 2005; Gedney et al. 1999; Knapp and Soulé 1998; Miller et al. 2005, 2007).

Figure 4 – Deteriorated aspen clone on the Heppner Ranger District (photo by D.C. Powell). This clone was burned during the Wheeler Point wildfire in 1996 (and it is located in the Kahler planning area) and most of the overstory trees died as a result of their fire-caused injuries, although occasional trees survived (as shown at far right). When this image was acquired a year or two after the fire, there were no aspen suckers under the dead overstory trees, indicating that (1) clonal vigor had declined to a point where the root system could no longer produce any suckers, or (2) any limited amount of suckering was immediately removed by ungulate herbivory. In most instances, aspen responds to fire by producing a profusion of suckers, but this image illustrates that fire can kill clones when their pre-fire vigor is very low. If an objective is to reestablish viable aspen on sites such as this one, it may be necessary to fence the area and then out-plant aspen seedlings or rootstock.

Riparian areas represent a dynamic interface or ecotone between water- and land-based ecosystems, where components of both systems interact. This is especially true for class IV (intermittent) RHCAs because they represent the driest riparian environments in the Kahler planning area. In virtually every instance, the floristic composition of Kahler's class IV RHCAs is identical to the floristic composition of adjacent, non-RHCA areas (the 'uplands'). Several studies concluded that disturbance processes and other ecosystem characteristics vary little (or not at all) between upland sites and adjacent class IV RHCAs (Everett et al. 2003, Olson 2000).

"Olson (2000) found fire occurrence in riparian zones to be only slightly less frequent than on adjacent uplands in similar forest types in the Blue Mountains in Oregon" (Wright and Agee 2004, p. 454). As Olson noted in her thesis: "Keeping fire out of the ecosystem will not only continue to alter the structure and vegetational composition of these riparian forests, but will also allow the buildup of fuels that could result in unprecedented fire intensities, and subsequently higher fire severities, than were present in the system historically. If the goal of forest management is to restore historical disturbance regimes to these forests, results from this study indicate riparian forests should be managed according to the historical fire regime of the forest type rather than distance from a stream" (Olson 2000, p. 78) (in this context, "distance from a stream" refers to a process of using designated buffer widths (in feet), varying by stream class, to establish riparian habitat conservation areas).

Figure 5 – Class IV RHCA in a dry-forest biophysical environment of the Kahler planning area (photo by Jonathan Day). Note that the predominant species in this RHCA is ponderosa pine, a tree adapted to fire-dependent ecosystems evolving in response to cyclical surface fire on a return interval of 5-20 years for the Blue Mountains. Also note the presence of a small patch of snowberry (probably common snowberry, *Symphoricarpos albus*) in the center of the photograph. Areas adjacent to the snowberry are dominated by herbaceous plants, probably rhizomatous graminoids such as pinegrass (*Calamagrostis rubescens*) and elk sedge (*Carex geyeri*). In this forest setting, snowberry is an indicator of slightly increased soil moisture, but it is certainly not a riparian shrub (e.g., snowberry is not considered to be a riparian-obligate plant species in this ecological setting). Therefore, vegetation on this site represents a soil moisture continuum, with graminoids predominant on sites with slightly less soil moisture, and snowberry prevailing in areas with slightly elevated soil moisture. Note that this upper portion of a class IV RHCA occupies a slightly concave, swale-like landform lacking obvious evidence of water scour or channel incision.

Information about management of class IV RHCAs in dry-forest biophysical environments, including a synthesis of relevant research about this issue, is provided in a recent white paper entitled: "New perspectives in riparian management: Why might we want to consider active management for certain portions of riparian habitat conservation areas?" (Powell 2014c). Specialist reports for soils (Archuleta 2014), fisheries (Dowdy 2014), hydrology (Farren 2014), fuels (Marshall 2014), and wildlife (Scarlett 2014) provide additional discussion and rationale for dry-forest RHCA thinning treatments, and how these treatments relate to PACFISH standards, guidelines, and riparian management objectives.

Thinning is proposed for app. 17% of class IV RHCAs for alternative 2 (proposed action) (16% of class IVs for alt. 3). Thinning treatments are designed to move RHCA conditions for species composition, forest structure, and stand density toward their historical range of variation. When preparing class IV RHCA treatments, unit layout considerations will occur in consultation with the fisheries biologist or hydrologist to ensure channel stability, ground and canopy cover, and riparian function objectives are addressed.

Treatments will use a variable-width, no-mechanical-equipment zone adjacent to stream channels. The no-mechanical-equipment zone width varies depending on topography, stream type, and vegetation type. Within portions of the no-mechanical zone, some commercial-size trees will be harvested if equipment can reach in and 'grab' them without actually entering the zone itself. Hand thinning of small-diameter, noncommercial trees (those less than or equal to 7 inches in diameter) will also occur in certain portions of the no-mechanical zone. Some trees will be felled along class IV channels and left there to provide down wood, and to otherwise contribute to RHCA function.

Summary: Desired Outcomes Related to Proposed Silvicultural Activities

Implementing silvicultural activities described in this section and table 1 (e.g., variable-density and ICO thinning with skips and gaps, noncommercial thinning, juniper thinning and shrub-steppe enhancement, dry-forest RHCA thinning, aspen restoration, reforestation, and prescribed fire) is expected to result in these future outcomes for the Kahler planning area:

- Ponderosa pine forest consists of a mosaic of varied tree sizes, densities, and understory vegetation. Open canopies predominate on 40 to 85 percent of a landscape; denser conditions occur on 5 to 30 percent. Stands are dominated by ponderosa pine trees; Douglas-fir and grand fir trees are typically associated with denser conditions on north slopes and canyon bottoms. Early-seral vegetation consisting of shrubs, herbs, and young trees occurs as small inclusions within larger forest patches.
- Heterogeneity is high due to variation in tree density and the presence of grassy openings interspersed with trees. Individual trees, small clumps, and groups of trees occur in a mosaic pattern with shrubs and herbs in variable-sized openings. This heterogeneity provides ecological integrity and properly functioning wildlife habitat for white-headed woodpecker, flammulated owl, and similar species.
- Old forest (large-diameter and old-age trees, snags, down logs) is present across 40 to 75 percent of the landscape. Old forest contains at least 10 trees per acre greater than 21 inches in diameter (and most of them are greater than or equal to 150 years of age).
- In mesic areas, canopy gaps and small openings provide favorable sites for regeneration, growth, and potential expansion of quaking aspen clones.
- Forests contain mostly vigorous trees, but declining trees also occur, providing wildlife nesting and denning habitat and ensuring future production of snags, down logs, and coarse woody debris. Areas of declining and dead trees typically occur as small patches within larger forest stands.
- Shrublands containing bitterbrush or mountain mahogany are vigorous and occur as a mosaic of varying age and size classes. Shrubs provide ample wildlife browse, particularly for winter range areas, but ungulate herbivory is not severe enough to prevent shrub regeneration.
- Woodlands comprised of western juniper occupy their historical habitats, and western juniper trees occur at historically appropriate levels of abundance, size, and density in both rangeland (nonforest) and forest environments. Prescribed fire is successful at maintaining low levels of juniper abundance in the understory of dry-forest stands dominated by ponderosa pine.

- Vegetation conditions provide sustainable amounts of wood fiber, forage, firewood, special forest products, and first foods for commercial, tribal, and personal uses. Common camas (*Camassia quamash*), bitterroot (*Lewisia rediviva*), cous biscuitroot (*Lomatium cous*), yampah (*Perideridia gairdneri*), big huckleberry (*Vaccinium membranaceum*), and other plants with traditional and cultural uses are plentiful and sustainable.
- Composition, structure, and density of forest vegetation are resilient to fire, drought, insects, diseases, and climate change, and they are resistant to invasion by non-native species. Future resilience is sufficiently high to allow forests to tolerate outbreaks of rarer agents such as pine butterfly (Flowers and Kanaskie 2010).
- Treatments enhance the quality of upland forest habitat, improve the diversity and productivity of riparian plant communities, and increase water availability for native vegetation (Grant et al. 2013).
- Dwarf mistletoe, root diseases, pine beetles, and other pathogens or insects are limited to individual stands (i.e., they are not occurring at a landscape or uncharacteristic scale).
- Fires burn with low, moderate, and high severity, allowing ecosystems to function in a healthy and sustainable manner. Low fire severity, resulting in less than 25% overstory-tree mortality, predominates on 60 to 90 percent of a landscape. Surface fire affects patches from 50 to 3,000 acres, with surface-fire areal extents near 1,000 acres being most common (Heyerdahl 1997).
- Fuel conditions across the planning area pose low wildfire risk to communities, structures, and other infrastructure. Fires in the WUI (wildland-urban interface) are predominantly of low to moderate intensity, allowing direct-suppression tactics to be employed.

Resource Indicators and Measures

Resource indicators are used to describe the status of forest vegetation conditions, and they are used to quantify vegetation changes for analyzing the effects (environmental consequences) of different actions on the Kahler planning area. Species composition, forest structure, and stand density are three measures used when evaluating forest vegetation conditions and trends for this project; they provide meaningful measures to develop an overall picture of forest vegetation historically, presently, and into the future. An indicator is also associated with each measure (Table 2).

During analysis of forest vegetation conditions, calculations and results are stratified by potential vegetation. The methodology for using potential vegetation to support forest vegetation analyses is described next in a Potential Vegetation section.

Table 2: Resource indicators and measures for assessing effects (environmental consequences)

Resource Element	Resource Indicator	Measure	Addresses Purpose & Need?	Source
Species composition	Forest cover types	Cover type percent	Yes	Martin 2010 letter
Forest structure	Structural stages	Structural stage percent	Yes	Martin 2010 letter
Stand density	Density classes	Density class percent	Yes	Martin 2010 letter

Potential Vegetation

Potential vegetation types consist of plant associations, plant community types, or plant communities. Potential vegetation types are grouped into plant association groups (PAGs), and PAGs are grouped into potential vegetation groups (PVGs) (Powell et al. 2007).

The Kahler analysis area consists almost entirely (87%) of the dry upland forest potential vegetation group (Dry UF PVG). Moist upland forest (Moist UF PVG) makes up a very small portion of the project area (1%) (Table 3). For descriptions of PVGs, including lists showing potential vegetation types assigned to each PVG, see table 4 and Powell et al. (2007).

Table 3: Potential vegetation composition of the Kahler planning area

Potential Vegetation Group	Area (Acres)	Percentage
Dry Upland Forest	28,600	87
Moist Upland Forest	380	1
Nonforest (No PVG assigned)	3,860	12
Total	32,840	100

Notes: Summarized from the Kahler vegetation database; acreage in this table pertains to the entire planning area, not just to the forest vegetation affected environment. Potential vegetation groups are described in Powell et al. (2007).

Table 4: Potential vegetation types (PVT) of the Kahler forest vegetation affected environment, organized by potential vegetation group (PVG)

PVG	Ecoclass	PVT Code	PVT Common Name	Acres
Dry Upland Forest	CDG111	PSME/CAGE2	Douglas-fir/elk sedge	4,460
	CDG112	PSME/CARU	Douglas-fir/pinegrass	8,130
	CDS624	PSME/SYAL	Douglas-fir/common snowberry	4,950
	CDS625	PSME/SYOR2	Douglas-fir/mountain snowberry	690
	CWG111	ABGR/CAGE2	Grand fir/elk sedge	2,990
	CWG113	ABGR/CARU	Grand fir/pinegrass	1,310
	CPG111	PIPO/AGSP	Ponderosa pine/bluebunch wheatgrass	20
	CPG222	PIPO/CAGE2	Ponderosa pine/elk sedge	1,090
	CPS233	PIPO/CELE3/PONEW	Ponderosa pine/mountain mahogany/Wheeler bluegrass	320
	CPG112	PIPO/FEID	Ponderosa pine/Idaho fescue	320
	CPS226	PIPO/PUTR2/FEID-AGSP	Ponderosa pine/bitterbrush/Idaho fescue-bluebunch wheatgrass	1,980
	CPS524	PIPO/SYAL	Ponderosa pine/common snowberry	200
Moist Upland Woodland	CJG111	JUOC/FEID-AGSP	Western juniper/Idaho fescue-bluebunch wheatgrass	1,210
	CJS321	JUOC/PUTR2/FEID-AGSP	Western juniper/bitterbrush/Idaho fescue-bluebunch wheatgrass	560
Moist Upland Forest	CWC812	ABGR/TABR2/LIBO3	Grand fir/Pacific yew/twinflower	220
	CWF312	ABGR/LIBO3	Grand fir/twinflower	40
	CLF211	PICO(ABGR)/LIBO3	Lodgepole pine(grand fir)/twinflower	120

Notes: Summarized from the Kahler vegetation database. Potential vegetation types are described in Johnson and Clausnitzer (1992). Potential vegetation groups are described in Powell et al. (2007).

Forest Species Composition: Cover Types

Tree species composition is evaluated by using forest cover types, which are named for tree species with the greatest percentage of stocking in a stand. The grand fir cover type, for example, contains a greater percentage of grand fir than other tree species, such as Douglas-fir or western larch, but a polygon with grand fir as the forest cover type would not be expected to have a pure composition of grand fir.

Forest Structure: Structural Stages

Forest structure describes tree canopy layers and life stages of a forest stand (Oliver and Larson 1996). Range of variation direction for the Umatilla NF includes five structural stages (Martin 2010): stand initiation, stem exclusion, understory reinitiation, old forest single stratum, and old forest multi-strata. The forest structural stages are described and illustrated in Powell 2014a (page 76) and in Powell 2014b (page 30); both sources are incorporated by reference in this forest vegetation specialist report.

Forest Stand Density: Density Classes

Forest density is a measure of the amount of tree vegetation on a unit of land. It can be described as basal area (BA), stand density index (SDI) (Reineke 1933), or by using other parameters. Stocking is the proportion that any particular measurement of stand density bears to a standard expressed in the same units.

Local, site-specific stocking guidelines (Cochran et al. 1994, Powell 1999) are used to analyze stand density levels to infer whether they are stocked with trees at a low, moderate, or high level. Forests with high density levels generally occur in a self-thinning zone where trees aggressively compete with each other for moisture, sunlight, and nutrients. Forests in the self-thinning zone eventually experience mortality as crowded trees die from competition, or as they are killed by insects or diseases that preferentially seek out stressed trees (Cochran et al. 1994, Powell 1999). By using suggested stocking guidelines in conjunction with potential vegetation groups, it is possible to determine the number of acres in each density class.

Methodology

The vegetation information used for analyses presented in this document was developed from on-the-ground stand exams, and by using the Most Similar Neighbor (MSN) imputation process (Crookston et al. 2002, Moeur and Stage 1995). The MSN algorithm uses canonical correlation analysis to derive a similarity function, and then chooses the most similar stand as a proxy from the global set of stands by comparing detailed design attributes (local variables) and lower-resolution indicator attributes (global variables). The most similar stand is selected by using the similarity function to maintain multivariate relationships between the global variables and the local variables.

Input data for MSN comes primarily from stand exams, as supplemented with remote-sensing data. Nearly all of the stand exam data for the Kahler planning area were collected in 2010 and 2011. Field reviews of the vegetation data were completed in 2011 and 2012, so the MSN data represents a 2012 baseline vegetation condition. Overall quality of the MSN imputations was relatively high – only 3 polygons had ‘poor’ quality (Table 5). Reference polygons (table 5) are those for which stand exams were completed.

Table 5: MSN imputation quality

Quality Rating	Number of Polygons	Percentage
Nonforest	76	7
OK	860	79
Poor	3	0
Reference	155	14
Total	1094	100

Notes: Each polygon included in the MSN process is assigned a quality value based on how accurate the resulting vegetation information is likely to be.

When estimating direct, indirect, and cumulative effects of implementing silvicultural activities for the Kahler Dry Forest Restoration Project, a four-step process is used:

1) Vegetation attribute information from MSN is transferred to spreadsheets.
2) Estimates of future transitions from one state (condition) to another are made (see Kahler Transition Matrix section later in this report).
3) Existing and future conditions are evaluated by comparing them to historical ranges (HRV) for three vegetation components (species composition, forest structure, and stand density).
4) Summary tables are generated for inclusion in this specialist report.

Historical Range of Variation Analytical Technique

The historical range of variation (HRV) analytical technique is used to evaluate existing and future conditions for all three of the forest vegetation components (measures) included in this analysis: species composition (forest cover type is the indicator), forest structure (structural stage is the indicator), and stand density (density class is the indicator) (table 2).

An HRV analysis is greatly influenced by scale. Therefore, it is recommended that an HRV analysis be completed for land areas no smaller than 15,000 to 35,000 acres (Powell 2014b). For this project, HRV evaluations are completed for a forest vegetation affected environment (AE) consisting of approximately 31,120 acres (the AE includes approximately 3,840 acres of nonforest grassland and shrubland), and this HRV analysis area is contained entirely within the 32,840-acre Kahler planning area.

After defining an HRV analysis area, the next step is to stratify the area into upland-forest (UF) potential vegetation groups (PVG). Three upland-forest PVGs have been defined for the Blue Mountains section of northeastern Oregon and southeastern Washington: dry, moist, and cold (Powell et al. 2007).

An upland-forest PVG comprising less than 1,000 acres in an HRV analysis area should be dropped from further consideration because such a small area would not be expected to produce a full range of composition, structure, and density conditions (Powell 2014b).

For the Kahler planning area, the moist upland forest PVG occupies approximately 380 acres, and there is no occurrence of the cold upland forest PVG. Therefore, HRV results are presented for neither the Moist nor Cold UF PVG, either because it doesn’t exist in the planning area (Cold UF), or it occupies less than 1,000 acres in the planning area (Moist UF). This means that all HRV analyses utilize only one of the three upland-forest PVGs – dry upland forest (Dry UF). The Dry UF PVG comprises app. 26,980 acres in the Kahler planning area.

An HRV analysis compares the existing amount of a vegetation condition with an historical range for the same condition (existing and historical amounts are both expressed as percentages). For all three of the resource measures and indicators (species composition, forest structure, and stand density), historical ranges used for the comparison exercise are contained in a letter from Kevin Martin, Forest Supervisor of the Umatilla National Forest (Martin 2010).

Incorporation by Reference: A Umatilla National Forest white paper entitled “Range of Variation Recommendations for Dry, Moist, and Cold Forests” (Powell 2014b) is incorporated by reference for the Kahler forest vegetation analysis. The white paper discusses the following items related to HRV: concepts and principles; ecosystem variation; RV as a planning tool; RV as a baseline; RV and climate change; ecosystem components used with an RV analysis; project planning and RV; glossary; an extensive reference section (literature cited); and a series of figures and tables relating to the RV analytical technique. Since the 58-page Range of Variation white paper (Powell 2014b) is incorporated by reference, most material from the white paper will not be repeated in this specialist report.

Information Sources

The Kahler forest vegetation analyses utilized a variety of information sources. Some of the vegetation characterizations were derived by using complex processes such as MSN imputation procedures. For this reason, the methodologies, modeling, and procedures employed during creation of forest vegetation databases are described in a separate specialist report (Justice 2014).

Concepts and principles about dry-forest management, and as related to the forest vegetation analyses described in this specialist report, are derived primarily from three sources: Franklin et al. (2013), Lillebo (2012), and Powell (2014a).

Silvicultural treatments described in this report are informed by two prescriptions prepared for silviculturist certification – both prescriptions involved stands located in the Kahler planning area (Day 2012, Spradlin 2011).

Incomplete and Unavailable Information

I am not aware of any incomplete or unavailable information that would have influenced the Kahler forest vegetation analyses.

Affected Environment

Table 6 presents a step-down process identifying a forest vegetation affected environment for the Kahler planning area. Forest Plan management areas designated as suitable for timber production are used to identify an affected environment for forest vegetation analyses. Figure 6 presents a map of the forest vegetation affected environment.

Table 15, presented in the Management Direction section later in this report, provides a list of the management areas contained in the Kahler planning area; it shows management areas designated as suitable for timber production by the Forest Plan.

Existing Conditions

Disturbances have influenced vegetation conditions for forested landscapes throughout the Blue Mountains, including the Kahler planning area. Bioregional assessments examining vegetation conditions and trends concluded that existing conditions for dry forests, such as those in the Kahler area, are uncharacteristic (departed) when compared with the historical (pre-European settlement) situation (Caraher et al. 1992, Gast et al. 1991, Henjum et al. 1994).

Table 6: Acreage summary for the Kahler forest vegetation affected environment

Approximate acreage of National Forest System (NFS) lands in the Kahler planning area	32,840
Minus NFS lands in unsuitable management areas A6, C1, and D2[1]	1,750
Total NFS lands within the affected environment	31,090
Plus NFS lands proposed for treatment in unsuitable management areas[2]	30
Total NFS lands in forest vegetation affected environment	31,120
Affected environment modified in alternative 1	0
Affected environment modified in alternative 2	12,220
Affected environment modified in alternative 3	11,540

[1] Management areas A6, C1, and D2 are unsuitable for timber production in the Forest Plan. Riparian Habitat Conservation Areas, a requirement of the PACFISH Forest Plan (FP) amendment, are also unsuitable, although timber harvest is permitted in RHCAs under certain circumstances. Forest Plan management area maps do not include RHCAs, so their acreage is not included in this line item.

[2] App. 30 acres of unsuitable management area near the Tamarack fire lookout and its associated administrative site are proposed for treatment. Since the proposal involves unsuitable lands, treatments can only be authorized with a site-specific FP amendment. To account for post-treatment changes, the 30 acres of Tamarack lookout lands are included in the forest vegetation affected environment.

Research studies (Hessburg et al. 1999, Johnson 1994, Lehmkuhl et al. 1994, Mutch et al. 1993, Oliver et al. 1994, Quigley and Arbelbide 1997, Tanaka et al. 1995, Wickman 1992), along with local watershed assessments and environmental analyses (USDA Forest Service 2004b), have shown that existing dry-forest conditions in the interior Pacific Northwest depart substantially from the historical situation, and that departures reflect the interacting effects of three historical factors: fire exclusion, herbivory from native and domestic ungulates, and selective timber harvest.

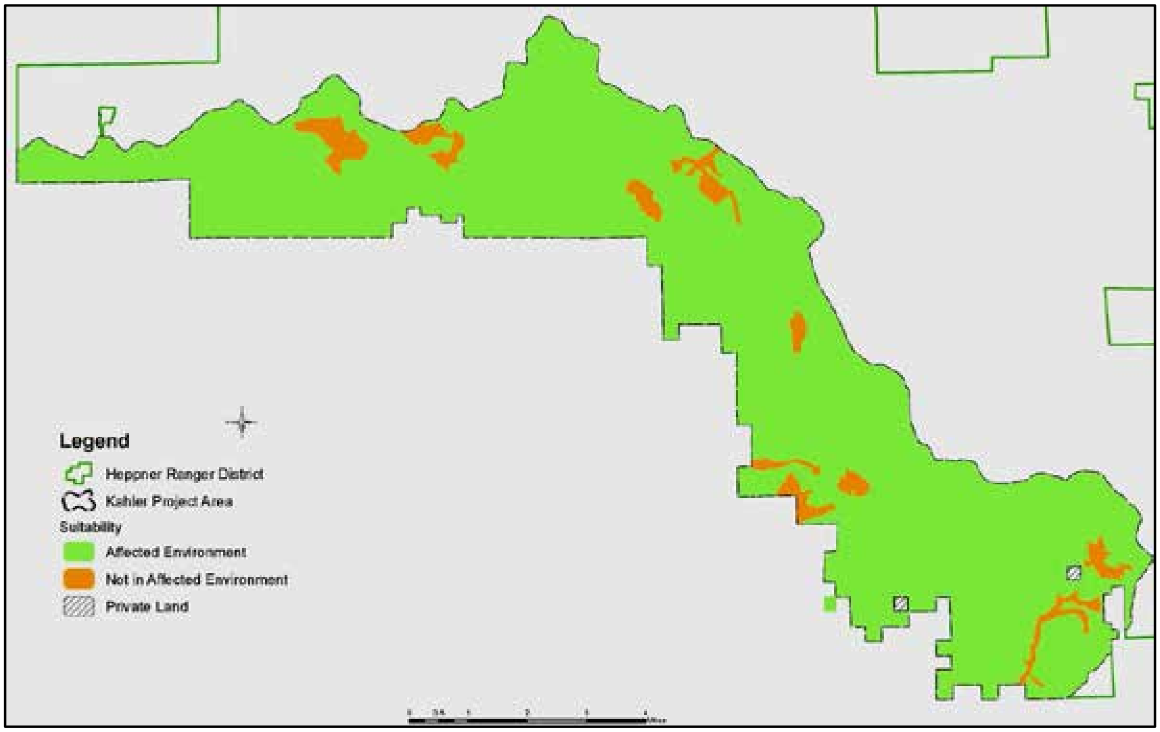


Figure 6 – Affected environment for forest vegetation analyses. The orange areas show locations of Forest Plan management areas that are unsuitable for timber management; they are not included in the affected environment for forest vegetation analyses.

Incorporation by Reference: A Umatilla National Forest white paper examines the effects of fire exclusion, ungulate herbivory, and selective timber cutting on the integrity and sustainability of dry-forest ecosystems, and it does so in the context of the Blue Mountains. The white paper, entitled "Active Management of Dry Forests in the Blue Mountains: Silvicultural Considerations" (Powell 2014a), is incorporated by reference for this Kahler forest vegetation analysis. The white paper discusses the following main topics related to dry-forest ecology and management: ecological setting; historical context; influence of fire exclusion on dry-forest ecosystems; influence of ungulate herbivory on dry-forest ecosystems; influence of selective timber cutting on dry-forest ecosystems; restoration of dry-forest ecosystems in the Blue Mountains; an extensive reference section (literature cited); and a series of figures and tables relating to dry-forest conditions and trends. Since the 179-page Dry Forests white paper (Powell 2014a) is incorporated by reference, most material from the white paper will not be repeated in this specialist report.

Western spruce budworm caused widespread tree damage and mortality in both Douglas-fir and grand fir in the 1980s and early 1990s; budworm damage:

1) Resulted in an increase in standing dead trees (snags).
2) Caused physical damage to trees (expressed as dead tops, sweep, crook, forks, etc.).
3) Contributed to production of down woody material now present as surface fuels and as wildlife habitat (Powell 1994, Sheehan 1996).

Figure 7 provides a year-by-year progression of spruce budworm activity for the Kahler planning area. This insect-caused disturbance process resulted in mortality of Douglas-fir and grand fir trees, along with substantially decreased growth and vigor for the surviving host trees, and it also created large accumulations of down wood in areas where tree mortality occurred.

Bark beetles and root disease continue to kill trees throughout the planning area, with western pine beetle causing mortality in large, old ponderosa pines, and mountain pine beetle killing younger pines occurring in high density conditions. Douglas-fir dwarf mistletoe is prevalent in Douglas-fir, and western dwarf mistletoe occurs in ponderosa pine, and both dwarf mistletoes are infecting understory regeneration (Schmitt and Spiegel 2010, 2012).

Timber harvest has been a disturbance agent in the Kahler area, and throughout eastern Oregon, for many decades (Oliver et al. 1994). District timber harvest records indicate past harvest in the Kahler planning area between 1940 and 2009 totaling app. 25,900 acres or 18,560 footprint acres (figure 8). Most of the acres harvested (app. 22,070 acres) involved single tree selection cuts or partial removals, where individual trees or clumps of trees, generally large-diameter ponderosa pines and Douglas-firs, were removed.

The remaining harvest acres used a variety of cutting methods, including clearcutting (app. 430 acres), shelterwood cutting (app. 190 acres), overstory removal cutting (app. 1,260 acres), seed-tree cutting (app. 200 acres), and commercial thinning (app. 740 acres). In addition, areas with no recorded timber harvest often show evidence of previous partial-removal timber harvest, with stumps and skid trails scattered throughout them.

Fire, and subsequent suppression of fire by humans, had an important influence on vegetation conditions in the planning area. Historical fire occurrence, in combination with previous timber harvest, is largely responsible for the composition of existing overstory trees (especially the older trees), whereas fire exclusion is primarily responsible for the composition of current understory trees.

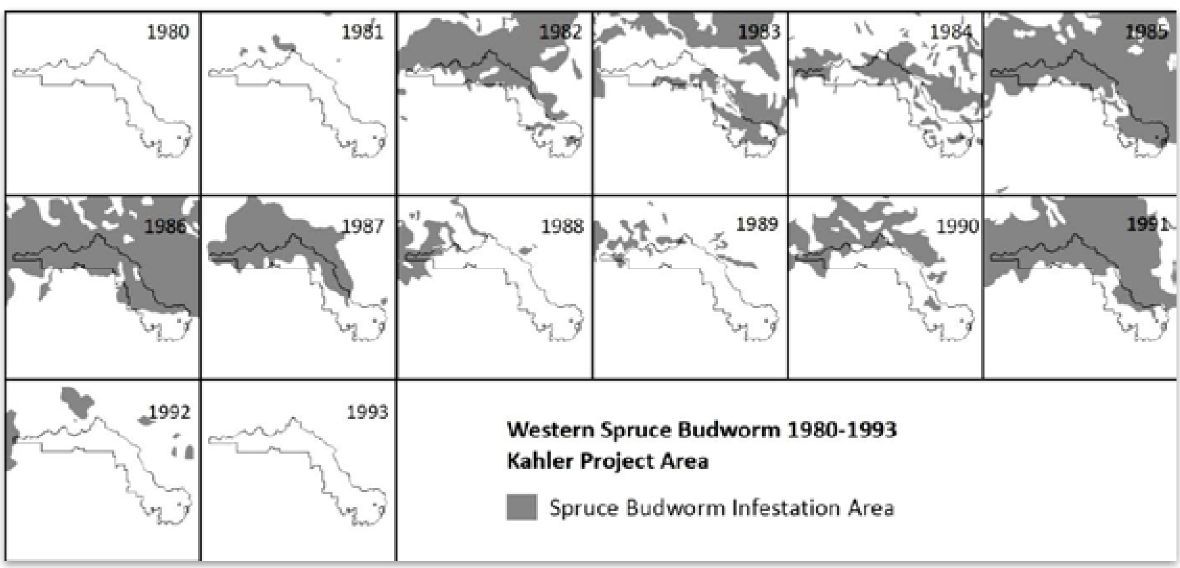


Figure 7 – Western spruce budworm activity between 1980 and 1993 for the Kahler planning area. Note that budworm defoliation was especially severe in 1982-83, 1985-87, and in 1991. Data derived from USDA Forest Service Region 6 Forest Health Protection Insect and Disease Aerial Detection Survey.

Dry upland forests once featured a mosaic of open park-like stands with a single-layer canopy, along with small inclusions of dense pine and fir regeneration. This structural condition has now transitioned to more uniform, dense, and multi-layered forests featuring abundant representation of shade tolerant species such as grand fir and Douglas-fir. The dry-forest white paper, which was incorporated by reference, explains these successional trends in more detail (Powell 2014a).

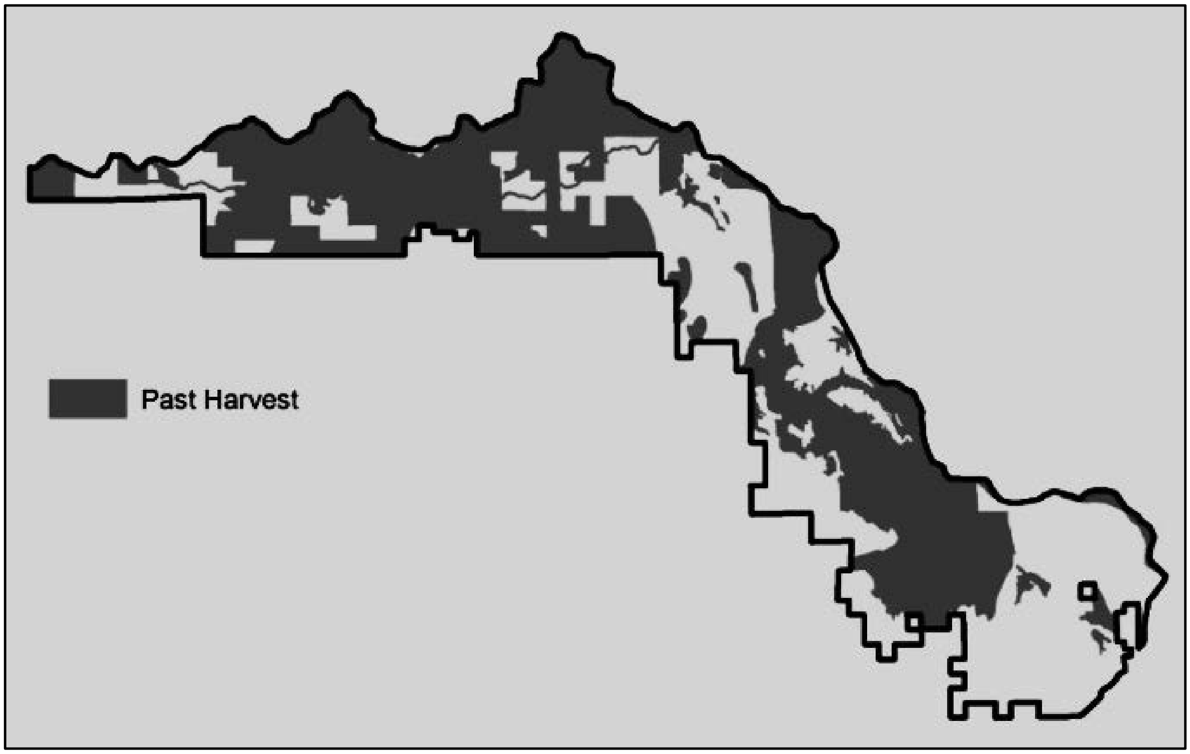


Figure 8 – Historical timber harvest in the Kahler planning area.

The Wheeler Point fire ignited on August 10, 1996 and grew rapidly to approximately 22,670 acres in size (see fig. 18). Approximately 7,500 acres of the fire affected National Forest System (NFS) lands; about 6,420 of NFS acres occur in the Kahler planning area. Effects of the Wheeler Point fire on dry-forest conditions in the Kahler planning area, where the fire burned mostly with uncharacteristic (stand-replacing) effects, are a definite management concern, both now and in the foreseeable future (fig. 9).

Existing Condition for Species Composition (Forest Cover Types)

Table 7 summarizes existing species composition (forest cover types) for the forest vegetation affected environment. It shows that the predominant forest cover type is ponderosa pine (55% of the affected environment has ponderosa pine as the majority or plurality tree species), followed by Douglas-fir (25%), nonforest grassland and shrubland (12%), and grand fir (5%). The spatial distribution of forest cover types for the affected environment portion of the Kahler planning area is presented in figure 10.

Figure 11 and table 8 summarize vegetation conditions for the Kahler planning area as of the 1880s. The information in figure 11 and table 8 was derived from interpretation of General Land Office survey notes recorded primarily between 1879 and 1887. A Umatilla National Forest white paper describes how the GLO survey notes were interpreted, and then converted into a geospatial data source (Powell 2013).

Table 8 shows that the predominant vegetation type in the Kahler planning area in the mid-1880s was ponderosa pine woodland or savanna (66% of the area), followed by mixed-conifer forest containing a mixed species composition (likely including ponderosa pine, Douglas-fir, and grand fir) (20% for the two mixed-conifer types combined), nonforest grassland and shrublands (10%), and five other miscellaneous vegetation types occurring at relatively low levels (2% of the planning area or less individually).

Figure 9 – Aftermath of the 1996 Wheeler Point fire, located within the Kahler planning area (photo acquired by D.C. Powell in fall of 1996 or spring of 1997). The fire effects shown here – almost total mortality of overstory trees, most of which were ponderosa pine and would have been resistant to the low-severity, high-frequency fires occurring historically in this area – are uncharacteristic for fire regime I (dry-forest) sites. Forest vegetation treatments proposed for the Kahler Dry Forest Restoration Project are designed to address existing vegetation conditions that, if fire were to occur in the near future (as it inevitably will), would likely result in further uncharacteristic fire effects. Also note that a strip of trees apparently survived (green and scorched crown is present) in the middleground portion of the photo; post-fire monitoring across a multi-year timespan showed that few of these trees actually survived, so they were not available to serve as a seed source and contribute to natural tree regeneration of the fire area.

Table 7: Existing condition for forest cover types of the Kahler forest vegetation affected environment

Forest Cover Type	Area (Acres)	Area (Percent)
Douglas-fir	7,760	25
Engelmann spruce	60	< 1
Grand fir	1,440	5
Lodgepole pine	10	< 1
Nonforest	3,840	12
Ponderosa pine	17,220	55
Quaking aspen	20	< 1
Western juniper	740	2
Western larch	30	< 1
Total	31,120	100

Notes: Summarized from the Kahler vegetation database. This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2).

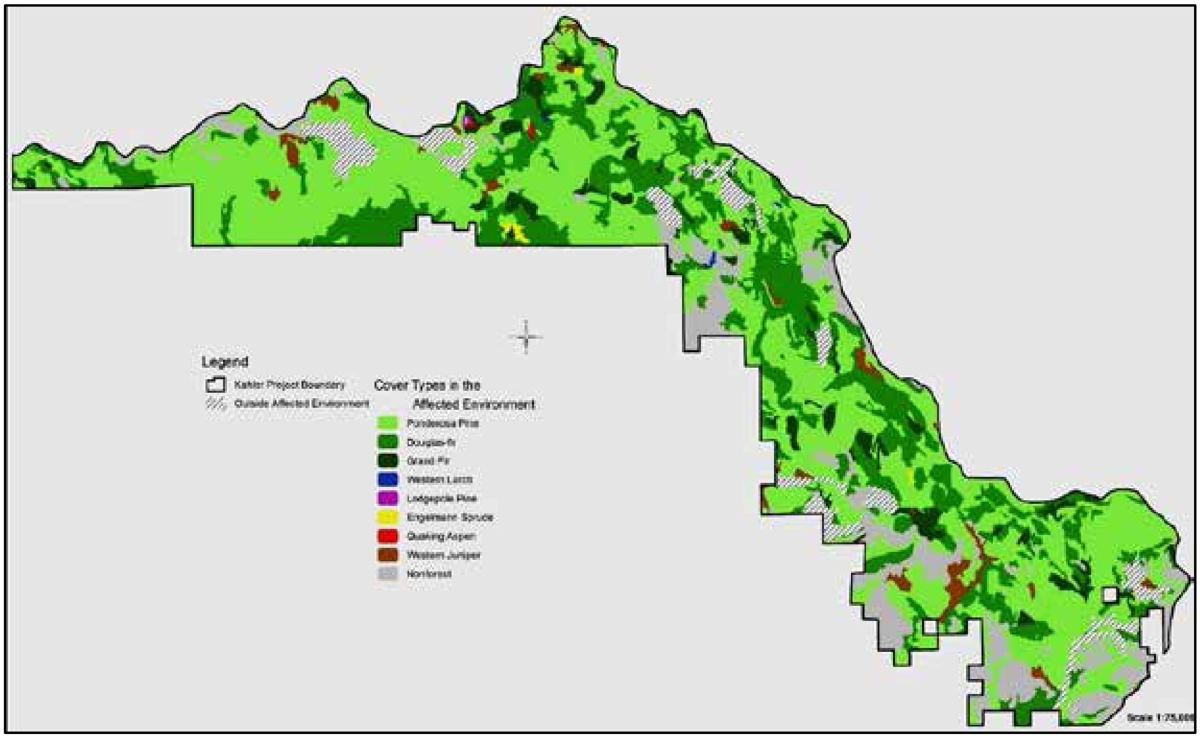


Figure 10 – Existing condition (2012) for forest cover types in the Kahler forest vegetation affected environment.

Note that the order of types listed in table 8 is the same order that types are shown in the map legend for figure 11.

The mid-1880s vegetation characterization agrees with soils information for the Kahler planning area. About 96% of the area's soils are Mollisols (Archuleta 2014), a soil order typically formed in grassland or herb-dominated environments (Meurisse et al. 1991). The presence of abundant Mollisols does not necessarily indicate that trees have invaded areas previously dominated by grassland or herbland, but it does suggest that during an historical time period spanning millennia, which is appropriate for evaluating soil-formation processes, the Kahler planning area was probably dominated by open, savanna-type forests.

Within the Kahler planning area, there also exists a small amount of quaking aspen. Aspen stands in the planning area are quite small (the largest stand occupies app. 9 acres, and many stands are 1 acre or less in size), so aspen typically occurs as inclusions within larger stands assigned to a coniferous cover type. Since aspen provides important ecosystem services related to its value as wildlife habitat and for vegetation biodiversity, it is carefully monitored during vegetation analysis, even though it seldom occurs in stands large enough to classify as a separate cover type. Known aspen occurrences for the Kahler planning area are summarized in table 9 and figure 12.

HRV Analysis for Forest Vegetation Affected Environment: Species Composition

An HRV analysis was completed for species composition of the Kahler forest vegetation affected environment (table 10). Because species composition varies by biophysical environment, the HRV analysis is stratified by potential vegetation group: dry upland forest (app. 26,980 acres). Note that Moist Upland Forest PVG is excluded because it has too few acres for a credible HRV analysis. The entire affected environment is included in table 10 except for nonforest (3,840 acres) and Moist UF PVG (300 acres).

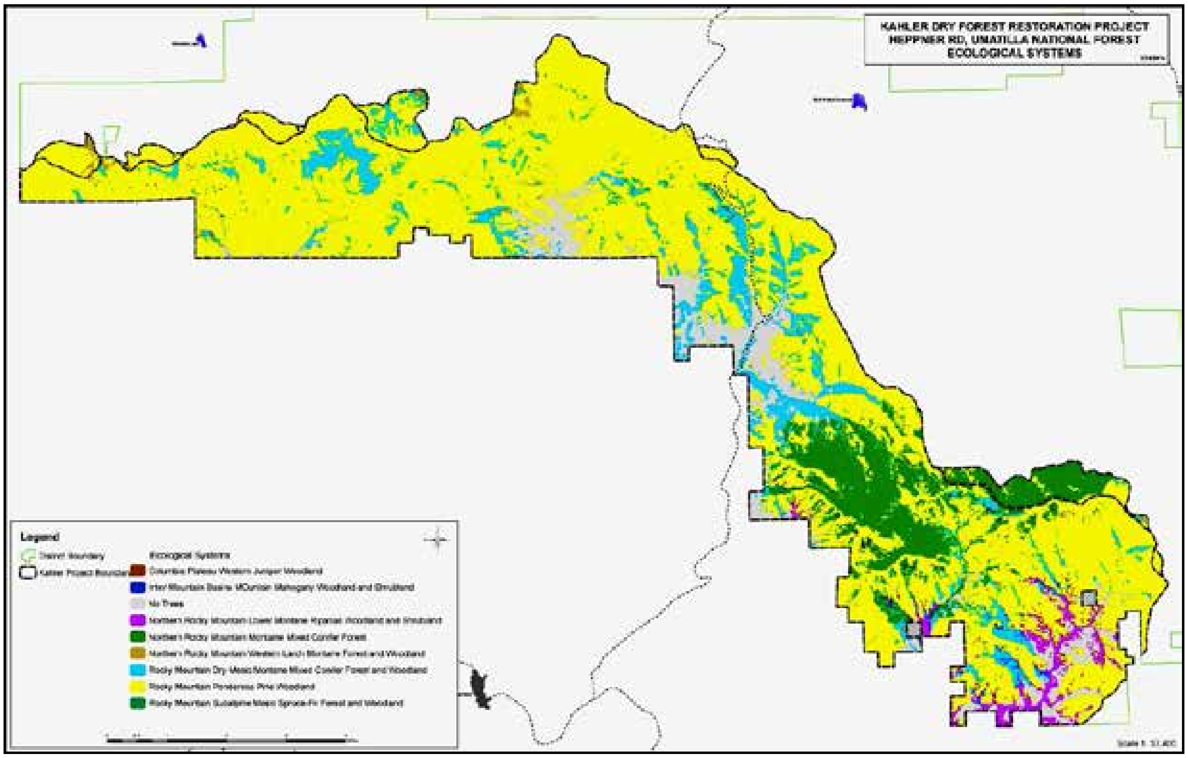


Figure 11 – Ecological systems for the Kahler planning area.

Table 8: Historical vegetation conditions for species composition (1880s) in the Kahler planning area

Ecological System	Area (Acres)	Area (Percent)
Columbia Plateau western juniper woodland	30	< 1
Intermountain Basins mountain mahogany woodland and shrubland	70	< 1
No trees (nonforest)	3,610	10
Northern Rocky Mtn. lower montane riparian woodland and shrubland (riparian forest)	660	2
Northern Rocky Mtn. montane mixed-conifer forest (mixed Douglas-fir and grand fir forest)	3,490	10
Northern Rocky Mtn. western larch montane forest and woodland (western larch forest)	270	1
Rocky Mtn. dry-mesic montane mixed-conifer forest and woodland (mixed ponderosa pine and Douglas-fir forest)	3,540	10
Rocky Mtn. ponderosa pine woodland	23,230	66
Rocky Mtn. subalpine mesic spruce-fir forest and woodland (Engelmann spruce forest)	80	< 1
Total	34,980	100

Notes: Detailed descriptions of the ecological systems are provided by NatureServe 2003 (http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5210199.pdf). A white paper describes how a map depicting ecological systems of the Umatilla National Forest was prepared (Powell 2013).

Table 9: Information about known occurrences of quaking aspen within the Kahler planning area

Link Number	Area (Acres)	Fenced?	Comments
409	5.17	No	This unit desperately needs to be thinned
519	0.28	No	All mature aspen is dead
520	1.00	No	No mature aspen
521	4.97	No	This unit is very spread out, with a lot of small and big conifers growing in it, but it isn't overly crowded
526	2.40	No	Very swampy and spread out
529	0.78	Yes	Even though there is only 1 mature tree and it looks to be dead, the stand is having no trouble reproducing
532	0.05	No	There are no mature individuals in this stand, but there are several young aspen and they are reproducing successfully. Along steep edge of creek
534	1.05	Yes	This stand is mostly, if not entirely, made up of cottonwoods. We only located one tree that could possibly be an aspen but were unable to get next to it to identify it. No sprouting
535	1.86	No	This stand is only made up of about 20 seedlings. There are no mature aspen that could be found in the area
578	1.06	No	
584	5.14	No	
585	9.19	Yes	This unit has already been thinned, but there are still several large conifers in unit. Lots of dead trees (snags)

Notes: Summarized from the Umatilla National Forest aspen database (UmaAspen_62013.mdb). This information was current as of autumn 2013, but several new aspen occurrences have been discovered during unit layout activity for the Kahler Dry Forest Restoration Project, and they will be added to the Forest's aspen database as soon as possible. Comments are taken verbatim from the aspen database.

Forest cover types are used as an indicator for the species composition measure. Information presented in table 10 suggests that the Douglas-fir forest cover type is currently over-represented on Dry UF PVG sites because it exceeds the upper limit of the historical range of variation (HRV). The western larch cover type is under-represented because it is slightly below the lower limit of its historical range. The western juniper, ponderosa pine, and grand fir cover types occur within their historical ranges, so their current representation in the Kahler planning area is appropriate for Dry Upland Forest sites.

Existing Condition for Forest Structure (Forest Structural Stages)

Table 11 summarizes existing forest structure (structural stages) for the Kahler forest vegetation affected environment. It shows that the predominant forest structural stage is stem exclusion (30% of the affected environment has a stem exclusion structural stage), followed by understory reinitiation (28%), stand initiation (17%), and nonforest grassland and shrubland (12%). The spatial distribution of forest structural stages for the affected environment portion of the Kahler planning area is presented in figure 13.

HRV Analysis for Forest Vegetation Affected Environment: Forest Structure

An HRV analysis was completed for forest structure of the Kahler forest vegetation affected environment (table 12). Because forest structure varies by biophysical environment, the HRV analysis is stratified by potential vegetation group: dry upland forest (app. 26,980 acres). Note that Moist Upland Forest PVG is excluded because it has too few acres for a credible HRV analysis. The entire affected environment is included in table 12 except for nonforest (3,840 acres) and Moist UF PVG (300 acres).

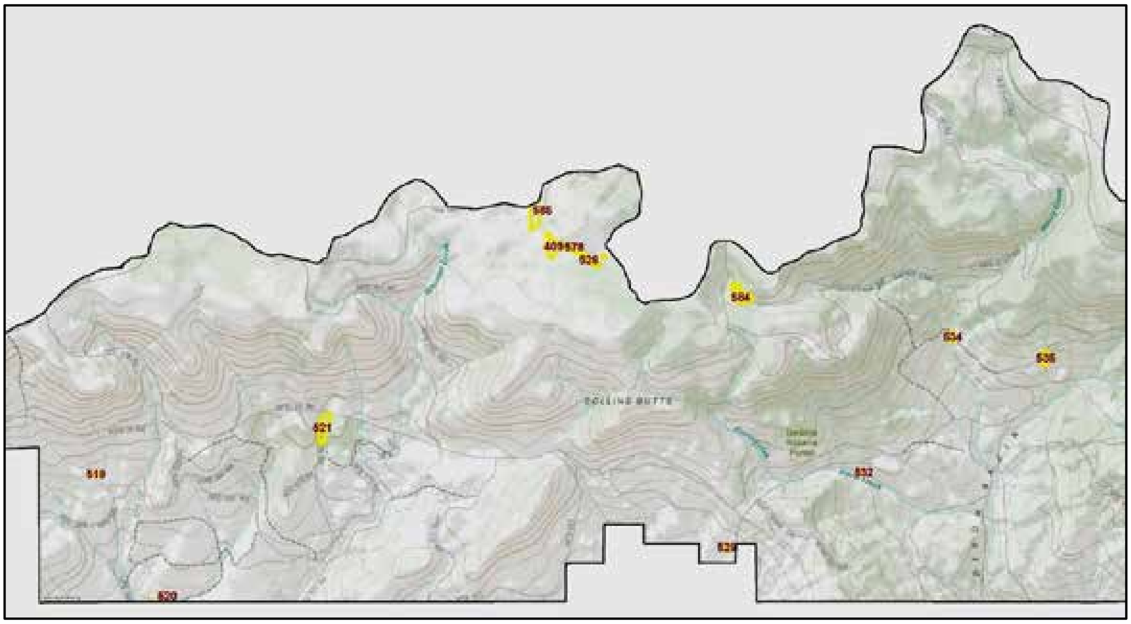


Figure 12 – Distribution of aspen stands within the Kahler planning area.

Table 10: HRV analysis for forest cover types of the Kahler forest vegetation affected environment

	DRY UPLAND FOREST PVG			
	Historical Range		Existing Amount	
Forest Cover Type	**Percent**	**Acres**	**Percent**	**Acres**
Douglas-fir	5-20	1,350-5,400	29	7,760
Grand fir	1-10	270-2,700	5	1,260
Ponderosa pine	50-80	13,500-21,600	64	17,220
Lodgepole pine	0	0	0	0
Subalpine fir and spruce	0	0	0	0
Western larch	1-10	270-2,700	0	0
Western juniper	0-5	0-1,350	3	740
Western white pine	0-5	0-1,350	0	0
Whitebark pine	0	0	0	0
Total			101	26,980

Notes: Existing amounts are taken from the Kahler vegetation database. Gray shading indicates cover types that are above or below the historical range of variation. Historical ranges are taken from Martin (2010). Lodgepole pine, subalpine fir and spruce, and whitebark pine have zeroes for historical ranges because they would not be expected to occur on the dry upland forest biophysical environment. This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2). It does not include: 1) aspen acreage (because an historical range is not provided for aspen in Martin 2010); 2) Dry UF acreage located outside of the affected environment but within the Kahler planning area; or 3) Moist UF PVG or nonforest acreage.

Table 11: Existing condition for forest structural stages of the Kahler forest vegetation affected environment

Forest Structural Stage	Area (Acres)	Area (Percent)
SI: Stand Initiation	5,140	17
SE: Stem Exclusion	9,330	30
UR: Understory Reinitiation	8,690	28
OFSS: Old Forest Single Stratum	1,550	5
OFMS: Old Forest Multi-Strata	2,580	8
Nonforest (no structure assigned)	3,840	12
Total	31,130	100

Notes: Summarized from the Kahler vegetation database. Nonforest is not a forest structural stage, but it is included to account for all of the affected environment acreage within the Kahler planning area. This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2).

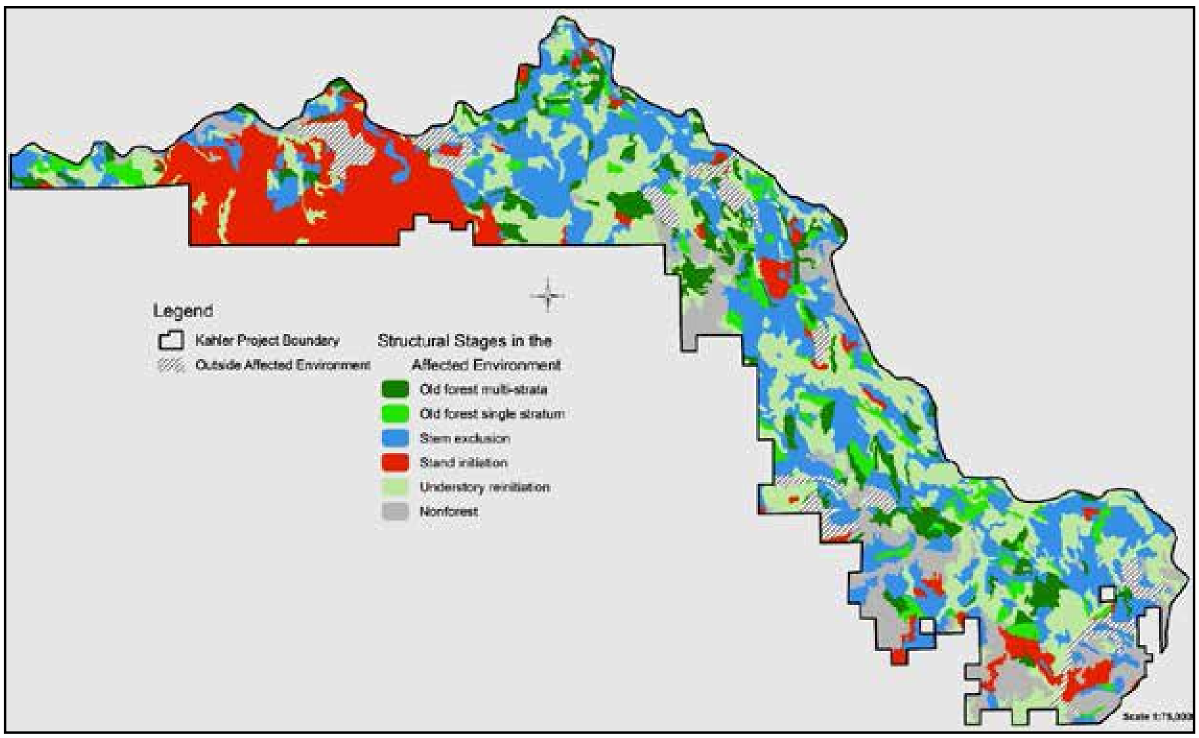


Figure 13 – Existing condition (2012) for forest structural stages in the Kahler forest vegetation affected environment.

Forest structural stage is used as an indicator for the forest structure measure. The information presented in table 12 suggests that the stem exclusion and understory reinitiation forest structural stages are currently over-represented on Dry UF PVG sites because they exceed the upper limits of their historical ranges of variation. The old forest single stratum forest structural stage is under-represented because it is below the lower limit of the historical range of variation. The stand initiation and old forest multi-strata structural stages occur within their historical ranges, so their current representation in the Kahler planning area is appropriate for Dry UF PVG sites. [Note that much of the stand initiation structural stage is concentrated in just one portion of the affected environment – the 1996 Wheeler Point fire (figs. 2, 9) – rather than being dispersed across the whole affected environment as would have occurred historically (Powell 2014a).]

Table 12: HRV analysis for forest structural stages of the Kahler forest vegetation affected environment

	DRY UPLAND FOREST PVG			
	Historical Range		Existing Amount	
Forest Structural Stage	Percent	Acres	Percent	Acres
SI: Stand Initiation	15-25	4,050-6,750	19	5,140
SE: Stem Exclusion	10-20	2,700-5,400	35	9,330
UR: Understory Reinitiation	5-10	1,350-2,700	32	8,600
OFSS: Old Forest Single Stratum	40-60	10,800-16,200	6	1,550
OFMS: Old Forest Multi-Strata	5-15	1,350-4,050	9	2,360
Total			101	26,980

Notes: Existing amounts are taken from the Kahler vegetation database. Gray shading indicates structural stages that are above or below the historical range of variation. Historical ranges are taken from Martin (2010). This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2). It does not include: 1) Dry UF acreage located outside of the affected environment; 2) Moist UF PVG; or 3) nonforest acreage.

Existing Condition for Stand Density (Stand Density Classes)

Table 13 summarizes existing stand density (density classes) for the Kahler forest vegetation affected environment. It shows that the predominant stand density class is high (40% of the affected environment has high stand density), followed by low stand density (33%), moderate stand density (15%), and nonforest grassland and shrubland (12%). The spatial distribution of stand density classes for the affected environment portion of the Kahler planning area is presented in figure 14.

Table 13: Existing condition for stand density classes of the Kahler forest vegetation affected environment

Stand Density Class	Area (Acres)	Area (Percent)
Low	10,190	33
Moderate	4,540	15
High	12,550	40
Nonforest (no density assigned)	3,840	12
Total	31,120	100

Notes: Summarized from the Kahler vegetation database. Nonforest is not a density class, but it is included to account for all of the affected environment acreage within the Kahler planning area. This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2).

HRV Analysis for Forest Vegetation Affected Environment: Stand Density

An HRV analysis was completed for stand density of the Kahler forest vegetation affected environment (table 14). Because stand density varies by biophysical environment, the HRV analysis is stratified by potential vegetation group: dry upland forest (app. 26,980 acres). Note that Moist Upland Forest PVG is excluded because it has too few acres for a credible HRV analysis. The entire affected environment is included in table 14 except for nonforest (3,840 acres) and Moist UF PVG (300 acres).

Stand density class is used as an indicator for the stand density measure. The information presented in table 14 suggests that the high stand density class is currently over-represented on Dry UF PVG sites because it exceeds the upper limit of its historical range of variation. The low stand density class is under-represented because it is below the lower limit of its historical range of variation. The moderate stand density class occurs within its historical range, so the current representation of moderate stand density in the Kahler planning area is appropriate for Dry UF PVG sites.

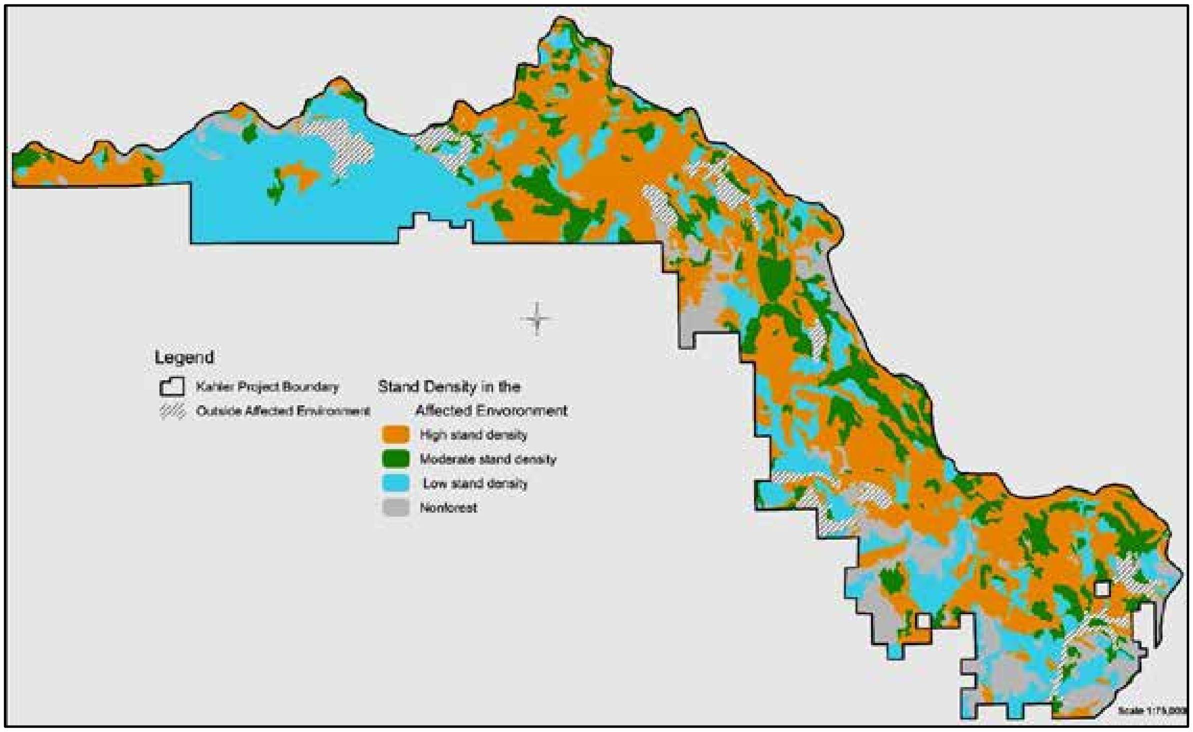


Figure 14 – Existing condition (2012) for stand density classes in the Kahler forest vegetation affected environment.

Table 14: HRV analysis for stand density classes of the Kahler forest vegetation affected environment

	DRY UPLAND FOREST PVG			
	Historical Range		Existing Amount	
Stand Density Class	**Percent**	**Acres**	**Percent**	**Acres**
Low	40-85	10,800-22,950	38	10,190
Moderate	15-30	4,050-8,100	17	4,520
High	5-15	1,350-4,050	45	12,270
Total			100	26,980

Notes: Existing amounts are taken from the Kahler vegetation database. Gray shading indicates stand density classes that are above or below the historical range of variation. Historical ranges are taken from Martin (2010). This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2). This analysis does not include Dry UF acreage located outside of the affected environment but within the Kahler planning area, or Moist UF PVG or nonforest acreage.

Management Direction

The most important factor influencing whether a forested area could be affected during implementation of an action alternative is management direction from the Land and Resource Management Plan for the Umatilla National Forest (the Forest Plan).

The Forest Plan evaluated all National Forest System lands for their capability, availability, and suitability for timber production (the suitability evaluation process is described in appendix J to the Final Environmental Impact Statement for the Forest Plan). As a result of the suitability evaluation, some forestland is designated as suitable for timber production, and other forestland is specifically designated in the Forest

Plan as being unsuitable for timber production. The timber suitability determination varied by Forest Plan management allocation area.

The Kahler planning area includes six management allocation areas, plus an additional designation for Riparian Habitat Conservation Areas (RHCAs) adjoining rivers, streams, and other wetlands – this Forest-wide riparian habitat allocation is referred to as PACFISH (USDA Forest Service; USDI Bureau of Land Management 1995).

Table 15 shows whether forestland in the Kahler planning area was designated as suitable for timber production, and whether timber harvest and prescribed fire are permissible management activities.

Table 15: Forest Plan forest vegetation direction summary for Kahler planning area

Management Area Allocation	Percent of Area	Suitable Lands?	Timber Harvest Permitted?	Planting Permitted?
A4: Viewshed 2	3	Yes	Yes	Yes
A6: Developed Recreation	< 1	No	Yes[1]	Yes
C1: Dedicated Old Growth	5	No	Yes[1]	Yes
C3: Big Game Winter Range	36	Yes	Yes	Yes
C5: Riparian (Fish and Wildlife)	2	Yes	Yes[1]	Yes
D2: Research Natural Area	< 1	No	No	No
E1: Timber and Forage	53	Yes	Yes	Yes
PACFISH (RHCAs)	[17][2]	No	Yes[1]	Yes

Sources/Notes: Management area allocations are from the Umatilla NF Forest Plan (USDA Forest Service 1990). The "percent of area" item shows the percentage of NFS lands in the Kahler planning area by management allocation; the "suitable lands?" item shows whether forested lands in the management area are suitable for timber production in the Forest Plan; and the "timber harvest permitted?" and "planting permitted?" items show whether timber management (commercial harvest, noncommercial activities, tree planting) is allowed by the management area standards and guidelines. Note that suitable lands were used to derive a forest vegetation affected environment for the Kahler planning area; see Affected Environment section earlier in this report.

[1] Timber harvest is permitted under limited circumstances for these allocations but with restrictions (the Forest Plan provides further detail about the timber harvest restrictions).

[2] PACFISH was not allocated to spatially explicit geographical units as was done for other management areas (e.g., PACFISH RHCAs are not shown on management area maps included with the 1990 Forest Plan), so the acreage for this allocation is contained in other management areas. The total acreage of RHCAs in the Kahler planning area is approximately 5,690 acres, which is 17% of the total planning area.

Design features, management requirements, and other implementation considerations for the forest vegetation silvicultural activities will be influenced by the Land and Resource Management Plan for the Umatilla National Forest (USDA Forest Service 1990).

Additional management direction is provided by amendments implemented after FP approval in 1990, including two amendments in particular:

- "Interim Management Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales" (USDA Forest Service 1995; also known as Eastside Screens); and
- "Interim Strategies for Managing Anadromous Fish-Producing Watersheds on Federal Lands in Eastern Oregon and Washington, Idaho and Portions of California" (USDA Forest Service; USDI Bureau of Land Management 1995; also known as PACFISH).

The Eastside Screens FP amendment focuses on the potential impact of timber sales on riparian habitat, historical vegetation patterns, and wildlife fragmentation and connectivity (USDA Forest Service 1995).

The PACFISH FP amendment establishes management direction designed to arrest and reverse declines in anadromous fish habitat (USDA Forest Service and USDI Bureau of Land Management 1994).

Desired Conditions

Narratives in this section describe Forest Plan direction influencing forest vegetation management and its associated treatments, practices, or activities; this direction pertains to the individual management areas.

A4, Viewshed 2; approximately 900 acres of National Forest System lands in the Kahler planning area – manage the area seen from a travel route, use area, or water body where some forest visitors have a major concern for the scenic qualities.

Desired Future Condition from FP: "Viewsheds will be managed primarily to meet the visual quality objectives of partial retention and modification. An attractive, near natural landscape will be maintained or created. A maximum of three distance zones for each viewshed including foreground, middleground, and background radiating from the viewer position have been delineated according to the process defined in Agriculture Handbook 462."

Management activities will be done with sensitivity to people's concern for scenic quality (Level 2), with vegetative manipulation conducted so that Forest management activities remain visually subordinate in foregrounds of selected travel routes and sites.

Forest stands will occasionally be logged in order to maintain long-term health and vigor, and to encourage a park-like, near natural appearance with big trees in the immediate foreground.

Some of the silvicultural treatment needs (adjustments to species composition, forest structure, and stand density), as identified in the project's Purpose and Need and occurring within the A4 management allocation, are included in the Kahler proposed action (alternative 2), and in alternative 3.

A6, Developed Recreation; approximately 50 acres of National Forest System lands in the Kahler planning area – provide recreation opportunities that depend on facility development for user conveniences in situations where interaction between users and evidence of other users is prevalent.

Desired Future Condition from FP: "Readily accessible, appropriately designed recreation facilities shall provide for concentrated use by people seeking a variety and convenience of developed recreation opportunities and experiences. Recreationists will enjoy outdoor opportunities where social interactions are moderate to high. Controls and regulations will be noticeable to obvious."

Created openings or tree removal shall occur to accommodate facility development, provide scenic views, or meet vegetation management goals within, and surrounding, the developed recreation sites.

Productive (capable) forestlands within an A6 allocation area are not suitable for timber management; any tree harvest is nonscheduled and would occur only to meet recreation objectives such as reducing the risk of public injury from hazardous trees (FP, pages 4-117 to 120).

None of the silvicultural treatment needs (adjustments to species composition, forest structure, and stand density), as identified in the project's Purpose and Need and occurring in the A6 management allocation, are addressed in the Kahler proposed action (alternative 2), or in alternative 3.

C1, Dedicated Old Growth; approximately 1,620 acres of National Forest System lands in the Kahler planning area – provide and protect sufficient suitable habitat for wildlife species dependent upon mature and/or overmature forest stands, and promote a diversity of vegetation conditions for such species.

Desired Future Condition from FP: "Old growth areas will be characterized by stands of naturally appearing overmature trees. Stands of mature trees may be included in the old growth category to provide a better distribution of this habitat type throughout the Forest. Trees in these stands are relatively large (with many trees greater 21 inches d.b.h.), past the point of rapid growth, and some have visible evidence of decay and decline including mycorrhizal fungi and other microorganisms. Other typical characteristics include a multi-layered, deep canopy with trees of two or more age classes and an abundance of both standing dead and down wood material. Stands will be dispersed in quantities and sizes which meet the needs of dependent wildlife species."

Management activities will normally be excluded within C1 areas except to enhance or perpetuate old growth forest habitat conditions.

Productive (capable) forestlands within a C1 allocation area are not suitable for timber management and tree harvest will not be scheduled or permitted. Fuelwood cutting, salvage harvest, or the removal of any dead or down material will not be permitted unless an old-growth unit is lost as a result of catastrophic conditions (FP, pages 4-144 to 146).

None of the silvicultural treatment needs (adjustments to species composition, forest structure, and stand density), as identified in the project's Purpose and Need and occurring in the C1 management allocation, are included in the Kahler proposed action (alternative 2), or in alternative 3.

C3, Big Game Winter Range; approximately 11,950 acres of National Forest System lands in the Kahler planning area – manage big game winter range to provide high levels of potential habitat effectiveness and high quality forage for big game species.

Desired Future Condition from FP: "Big game winter ranges will appear primarily as a mosaic of managed forests, brush patches, and large grasslands. Forested areas will contain a mix of harvested even-aged, uneven-aged, and natural stands, creating patterns of cover patches and forage areas for big game. Management activities may be locally apparent; created openings will range up to 25 acres in size. Where natural potential exists, cover areas will be developed and/or maintained to occur as groups of larger trees, 10 acres or more in size, with dense canopies. Use of prescribed fire will be apparent."

Productive (capable) forestlands within a C3 allocation area are suitable for timber management; all timber management practices and intensities are permitted when they are consistent with the big game and wildlife habitat goals.

Tree harvest cutting methods will emphasize uneven-aged management including individual-tree and group selection; commercial thinning may be used when consistent with the objective of maintaining satisfactory cover (FP, pages 4-151 to 154).

At least 10% of the total C3 acreage within a planning area will be maintained as satisfactory cover (canopy cover of 70% or more) (15-20% of the total acreage is desirable as satisfactory cover), with an additional 15-20% of the C3 acreage maintained as marginal cover (canopy cover of 40-69%). Total cover (satisfactory plus marginal) will total at least 30% of the C3 acreage in a planning area.

Some of the silvicultural treatment needs (adjustments to species composition, forest structure, and stand density), as identified in the project's Purpose and Need and occurring within the C3 management allocation, are included in the Kahler proposed action (alternative 2), and in alternative 3.

C5, Riparian; approximately 790 acres of National Forest System lands in the Kahler planning area – maintain or enhance water quality, and produce a high level of potential habitat capability for all species of fish and wildlife within designated riparian habitat areas, while also providing a high level of habitat effectiveness for big game.

Desired Future Condition from FP: "A near natural setting will predominate adjacent to the stream, with a wide variety of plant communities of various species, sizes, and age classes. In forested riparian zones, a continuous high tree canopy layer will be present and the forest will appear denser than in the surrounding land. Upper and mid-level conifer and hardwood canopy structure and lower shrub level will provide desired levels of stream surface shading, streambank stability, and satisfactory cover for big game."

Productive (capable) forestlands within a C5 allocation area are suitable for timber management; all silvicultural practices and intensities are permitted when compatible with water quality and anadromous fish and wildlife habitat goals (FP, pages 4-163 to 166).

Evidence of uneven-aged timber harvest (individual-tree and group selection cutting) will be common, but harvest will only cause minimal impact on riparian vegetation and visual quality.

Some of the silvicultural treatment needs (adjustments to species composition, forest structure, and stand density), as identified in the project's Purpose and Need and occurring within the C5 management allocation, are included in the Kahler proposed action (alternative 2), and in alternative 3.

D2, Research Natural Area; approximately 80 acres of National Forest System lands in the Kahler planning area – preserve naturally occurring physical and biological units where natural conditions and processes are maintained.

Desired Future Condition from FP: "The ecological community will continue to evolve through natural processes. Natural physical and biological conditions will be maintained, insofar as possible, to preserve the vegetation for which the area was created. Use, except for scientific and educational purposes, will be generally discouraged."

None of the silvicultural treatment needs (adjustments to species composition, forest structure, and stand density), as identified in the project's Purpose and Need and occurring in the D2 management allocation, are included in the Kahler proposed action (alternative 2), or in alternative 3.

E1, Timber and Forage; approximately 17,440 acres of National Forest System lands in the Kahler planning area – manage forest lands to emphasize production of wood fiber (timber) and encourage production of forage.

Desired Future Condition from FP: "Intensive management of forests for timber production and other commodity products will be apparent. The Forest will primarily be a diverse mosaic of even-aged stands of many age classes, with trees somewhat uniformly spaced and well stocked. Regenerated stands will generally range from 20-40 acres. Stands managed using uneven-aged principles will also be apparent, particularly in the ponderosa pine types. A diversity of species will be present in plantations, but seral, more pest-free species such as ponderosa pine, western larch, and lodgepole pine will be most evident. Larger trees will average 16-18 inches in diameter with the exception of trees left to meet cavity dependent wildlife needs and for the recruitment of large woody debris. Accumulated fuels will generally be light, and large destructive fire will seldom occur; prescribed fire will be an important management tool."

Some of the silvicultural treatment needs (adjustments to species composition, forest structure, and stand density), as identified in the project's Purpose and Need and occurring within the E1 management allocation, are included in the Kahler proposed action (alternative 2), and in alternative 3.

Interim Strategies for Managing Anadromous Fish-producing Watersheds (PACFISH); approximately 5,690 acres of National Forest System lands in the Kahler planning area – manage riparian habitat conservation areas to "arrest the degradation and begin the restoration of aquatic habitat and riparian areas on lands administered by the Forest Service and BLM; it applies to watersheds outside the range of the northern spotted owl that provide habitat for Pacific salmon, steelhead, and sea-run cutthroat trout" (USDA Forest Service; USDI Bureau of Land Management 1995).

PACFISH uses a buffer concept to establish riparian habitat conservation areas (RHCA) along both sides of streams, rivers, lakes and other wetlands. RHCA widths extend from the edge of the active stream channel, and they vary with stream class and whether a stream is fish bearing or not.

RHCAs can be established using specified feet of slope distance (such as 300 feet on either side of perennial, fish-bearing streams), or in numbers of 'site potential tree heights' (such as 2 site-potential tree heights for perennial, fish-bearing streams).

The interim RHCA widths established by the PACFISH environmental assessment could be adjusted during watershed analysis, or after site-specific analysis, presenting a rationale for RHCA modifications.

Timber management has one standard, TM-1, in the PACFISH amendment; it is quoted below in its entirety (see page C-10 in USDA Forest Service; USDI Bureau of Land Management 1995):

"Prohibit timber harvest, including fuelwood cutting, in Riparian Habitat Conservation Areas, except as described below. Do not include Riparian Habitat Conservation Areas in the land base used to determine the Allowable Sale Quantity, but any volume harvested can contribute to the timber sale program." [This statement renders PACFISH RHCAs as unsuitable in a Forest Plan context.]

a. "Where catastrophic events such as fire, flooding, volcanic, wind, or insect damage result in degraded riparian conditions, allow salvage and fuelwood cutting in Riparian Habitat Conservation Areas only where present and future woody debris needs are met, where cutting would not retard or prevent attainment of other Riparian Management Objectives, and where adverse effects on anadromous fish can be avoided. For watersheds with listed salmon or designated critical habitat, complete Watershed Analysis prior to salvage cutting in RHCAs."

b. "Apply silvicultural practices for Riparian Habitat Conservation Areas to acquire desired vegetation characteristics where needed to attain Riparian Management Objectives. Apply silvicultural practices in a manner that does not retard attainment of Riparian Management Objectives and that avoids adverse effects on listed anadromous fish."

Some of the silvicultural treatment needs (adjustments to species composition, forest structure, and stand density), as identified in the project's Purpose and Need <u>and</u> occurring within class IV riparian habitat conservation areas in the dry-forest biophysical environment (total acreage of class IV RHCA in the Kahler planning area is app. 4,050 acres), are included in the Kahler proposed action (17% of total class IV RHCA is treated in alternative 2), and in alternative 3 (16% of total class IV RHCA is treated in alternative 3) (class IV RHCA treatment acreages are presented in table 1).

Note that research conducted in dry-forest environments has consistently found that class IV RHCAs have a disturbance regime, and resulting vegetation characteristics, similar to those for adjacent uplands (Olson 2000, Williamson 1999). The dry-forest RHCA thinning discussion on pages 9-12, and a white paper specifically focused on management of class IV RHCAs in dry-forest environments (Powell 2014c), provide additional information about this situation.

Forest-wide Standards and Guidelines

Narratives in this section pertain to all national forest system lands located within the Umatilla National Forest; this direction is referred to as Forest-wide standards and guidelines. Forest-wide standards and guidelines influencing vegetation management activities are provided in the timber section of the Forest Plan (pages 4-67 to 4-76). Management area direction (as summarized above) takes precedence over Forest-wide direction.

a. Selected treatment methods must promote a stand structure and species composition minimizing risks from insects, disease, and wildfire (page 4-67).

b. A wide variety of treatment methods are allowed, including site preparation, tree improvement, reforestation, tree protection, release and weeding, noncommercial thinning, fertilization, pruning, commercial thinning (including improvement cutting), sanitation harvest, salvage harvest, and regeneration (final) harvest (shelterwood, seed-tree, clearcut, individual-tree selection, group selection) (page 4-68).

c. Noncommercial thinning is recommended when stocking-level control is necessary to protect a forest stand from losses due to insects and diseases (page 4-71).

d. Natural regeneration should be the preferred forest regeneration alternative where economic, stand, and site conditions are appropriate and where natural regeneration does not conflict with other resource objectives identified and documented during the project planning process (page 4-72).

e. When determining which conifer species to favor during development of silvicultural prescriptions, consideration should be given to the following objectives: long-term stand health, vigor, and productivity as specifically related to insect and disease impacts; economic efficiency; and biological diversity needs for wildlife species, visual quality, or other resource values (page 4-72).

f. For mixed-conifer forest (referred to as the "north and south associated working groups" in the Forest Plan), strong consideration should be given to maintenance of stands dominated by early-seral species, including ponderosa pine, western white pine and western larch, because the potential for insect and disease depredation is high if late-seral tree species are favored in these forest types (page 4-73).

   Note: The Forest Plan characterizes potential vegetation using four "working groups" – ponderosa pine, north associated, south associated, and lodgepole pine. During the planning process, each plant community type on the Forest (as described in Hall 1973) was assigned to a working group. The plant community type classification system of Hall (1973) was subsequently superseded by the plant association classification system of Johnson and Clausnitzer (1992). The plant associations described in Johnson and Clausnitzer (1992) can be cross-walked to Forest Plan working groups.

g. In the ponderosa pine working group, silvicultural prescriptions will feature ponderosa pine while other associated tree species will be maintained at low levels sufficient to provide for ecological diversity needs. In the lodgepole pine working group, tree species diversity should be encouraged by promoting western larch and Engelmann spruce (page 4-73).

   Note: The Forest Plan's ponderosa pine working group is analogous to the "dry upland forest" potential vegetation group (PVG) used throughout this report; the lodgepole pine working group is analogous to the "cold upland forest" PVG.

h. Special and unique ecological communities such as aspen and other hardwood species should receive special attention; silvicultural prescriptions will specifically address measures to protect, maintain, and enhance aspen and other hardwood clones, clumps, and sprouts (page 4-74).

i. When planning timber harvest projects, the need for long-term forest health and vigor achievable through density management treatments should take precedence over a short-term need for horizontal diversity (for wildlife habitat, visual quality, and recreation) (page 4-73).

j. Created Openings: item three in the "Horizontal Diversity" section (page 4-73) states, "the Forest will conform to the Regional guidelines on created forest openings. Forest openings created by even-aged silviculture should not exceed 40 acres. Exceptions are permitted in the following cases:

   i. When natural catastrophic situations such as fires, windstorms, or insect or disease attacks occur;

   ii. On an individual case by case basis after a 60-day public notice and review by the Regional Forester;

   iii. When any one of the criteria in the Regional Plan is met, but opening size shall not be exceeded by more than 50 percent without review by the Regional Forester or 60-day public notice."

a. Regional guidelines on created forest openings are provided in the description of alternative 3, Regional Guide/FEIS, page 2-9: "Forest openings created by the application of even-aged harvest cutting methods shall be limited to a maximum size of 60 acres in the Douglas-fir type of the coastal Douglas-fir zone, and to a maximum size of 40 acres for all other forest types in the Pacific Northwest Region.

b. Exceptions are permitted for natural catastrophic events (such as fires, windstorms, or insect and disease attacks) or on an individual basis after a 60-day public notice period and review by the Regional Forester.

c. In addition, the limits may be exceeded by as much as 50 percent without necessitating review by the Regional Forester or 60 days public notice when exceeding the limit will produce a more desirable combination of net public benefits and when any one of the following criteria is met.

    i. When a larger created opening will enable the use of an economically feasible logging system that will lessen the disturbance to soil, water, fish, riparian resources or residual vegetation. Such lessening is to be achieved by reducing landing or road construction, by enabling such construction away from unstable soil, or by reducing soil and vegetation disturbance caused by dragging logs.

    ii. When created openings cannot be centered around groups of trees infected with dwarf mistletoe or root rot and therefore need to be expanded to include these trees in order to avoid infection of susceptible adjacent conifers.

    iii. When visual quality objectives require openings to be shaped and blended to fit the landform.

    iv. When larger openings are needed to achieve regeneration objectives in harvest areas being cut by the shelterwood method and when destruction of the newly created stand would occur as a result of delayed removal of shelter trees. This exception applies only to existing shelterwood units and to shelterwood units under contract prior to approval of the Forest Plan."

d. Item four in the "Horizontal Diversity" section of the FP (page 4-73) states, "a harvested area will no longer be considered a created opening for timber management when the prescribed crop tree stocking is above minimum acceptable levels and trees are at or above 4½ feet in height and free to grow (MR). Where other resource management considerations are limiting, such as wildlife habitat and visual requirements, a created opening will no longer be considered an opening when the vegetation in it meets the management objective."

e. Table 16 provides "minimum acceptable levels" (see item d. above) to be used when determining whether post-harvest stocking levels meet the created opening standards described above.

Environmental Consequences

This section discloses the environmental consequences of implementing the silvicultural activities proposed for each of the alternatives. Subsections discriminate between:

1) Direct effects, which are caused by an activity (action) and occur at the same time and place.
2) Indirect effects, which are caused by an activity (action) and are later in time or farther removed in distance than direct effects, but are still reasonably foreseeable.
3) Cumulative effects, which result from the incremental impact of an activity (action) when added to other past, present, and reasonably foreseeable future actions.

Three indicators are used to characterize the environmental consequences of implementing the silvicultural activities associated with each of the alternatives: species composition (forest cover types), forest structural stages, and stand density classes. Potential vegetation is used in this section as a stratification factor for the range of variation analyses, but it is not used as an indicator because it is not affected, either directly, indirectly, or cumulatively, by silvicultural activity or management treatment.

Table 16: Minimum tree stocking levels for the Umatilla National Forest (from Martin 2014)

Average Stand Diameter After Harvest (Inches)	Minimum Acceptable Stocking Ponderosa Pine Working Group Live TPA	Minimum Acceptable Stocking Ponderosa Pine Working Group Live BAA	Minimum Acceptable Stocking South Associated Working Group Live TPA	Minimum Acceptable Stocking South Associated Working Group Live BAA
< 1	100		150	
1-5	90		150	
6	80	25	125	35
8	70	25	100	35
10	45	25	65	35
12	30	25	45	35
14	25	25	35	35
16	20	25	25	35
18	15	25	20	35
20	12	25	15	35
22	10	25	13	35
24+	8	25	12	35

Sources/Notes: Stocking levels for small diameters (< 1") are taken from the Umatilla NF Forest Plan (USDA Forest Service 1990), page 4-70. Standards for larger size classes are taken from Martin (2014). For the Kahler project, plant associations in the ponderosa pine series are the Ponderosa Pine working group; all other plant associations are the South Associated working group.

Effects Analysis

To predict direct, indirect, and cumulative effects of proposed silvicultural activities on the forest vegetation affected environment within the Kahler planning area, a state and transition model was created. To validate the model, a sample of 5 units with a range of plant associations was examined by using the Forest Vegetation Simulator (FVS) to quantify changes in composition, structure, and density. The proposed thinning actions, along with estimates of expected regeneration, were modeled in FVS for 50 years (2015-2065). Table 17 includes the units that were modeled by using FVS.

Based on results from FVS, the state and transition model is expected to predict future transitions (changes) from one state (condition) to another well. The state and transition model is then used to evaluate the effects of all three Kahler alternatives (including no action) across the affected environment.

Note that FVS simulation results, and the associated Kahler state and transition model (table 18), are used as a first approximation of future conditions in the planning area. *My professional judgment, in conjunction with my interpretation of integrated vegetation transitions (accounting for synergistic interactions between composition, structure, and density transitions occurring simultaneously), were used to adjust the state and transition model estimates.*

A state and transition model showing how composition (cover type), structure, and density vary through time was developed, primarily by using FVS to simulate long-term changes for benchmark (representative) units within the Kahler planning area. The benchmark units are described in table 17. Each of the three forest vegetation components (resource measures or indicators) is included in the state and transition model below (table 18).

Table 17: Subsample of units simulated with FVS to validate the state and transition model

Unit	FSVeg StandID	Plant Association	Structure	Cover Type	Density (SDI)
15	06140282130000207	CWG112	SE	Grand fir	355
27	06140282130000025	CPS226	UR	Ponderosa Pine	134
29	06140282130000088	CDS622	SE	Ponderosa Pine	252
50a	06140282250000183	CWG111	UR	Grand fir	280
57	06140282250000078	CDG112	SE	Douglas-fir	242

Table 18: State and transition model of predicted changes due to implementation of silvicultural activities

Resource Measure	Pretreatment State (2012)	Post-treatment State (2015)	Post-Treatment State (2065)
Structure[1]	SI	SI	SE
	SE	SE	OFSS
	UR	SE	OFSS
	OFMS	OFSS	OFSS
	OFSS	OFSS	OFSS
Density	Low	Low	Low
	Moderate	Low	Low
	High	Low	Low (65%)/Moderate (25%)/High (10%)
Cover Type	Ponderosa pine	Ponderosa Pine	Ponderosa Pine
	Douglas-fir	Ponderosa Pine	Ponderosa Pine
	Grand fir	Ponderosa Pine	Ponderosa Pine

[1] Structural stages are: stand initiation (SI), stem exclusion (SE), understory reinitiation (UR), old forest multi-strata (OFMS), and old forest single stratum (OFSS).

Details of transitions (changes from one state to another) in the state and transition model (table 18) are discussed below. The format for showing transitions is as follows:

Current state (2012) → State immediately after treatment (2015) → State after 50 years (2065)

Forest Structure

OFMS → OFSS → OFSS

Old forest multi strata stands will be treated by using a low thinning (‘thinning from below’), generally removing a lower stratum of canopy structure, thus moving stands to a single stratum structure. There will be on average at least 10 large trees (≥ 21" dbh) per acre retained after treatment, and follow-up underburning and noncommercial thinning will maintain a single stratum structure.

The objective of silvicultural treatments designed to instigate a transition from OFMS to OFSS is not solely to transform some of the OFMS structure, which is currently within its range of variation, to OFSS, which is below its range of variation, but also to create a post-treatment structure (OFSS) amenable to reintroduction of low-severity, high-frequency surface fire – a keystone ecosystem process on dry-forest sites (Powell 2014a).

[Note: OFMS is an old forest structural stage featuring at least one additional canopy layer beneath an overstory of large-diameter trees. The subordinate canopy layer(s) can function as ladder fuel, which constrains opportunities (prescribed-fire windows) to safely reintroduce surface fire on dry-forest sites.]

OFSS → OFSS → OFSS

Old forest single stratum (OFSS) stands will have minimal treatment, with some noncommercial thinning possibly occurring to improve tree vigor and thereby reduce susceptibility to western pine beetle, a primary killer of old, low-vigor ponderosa pine trees.

The primary objective of any near-term noncommercial thinning in OFSS stands is to improve the opportunity to safely apply prescribed fire because heat generated from consumption of small understory trees can place low-vigor overstory trees at high risk of post-fire mortality. Future underburning and noncommercial thinning will help keep the stand in a single stratum structure.

Initially, prescribed fire will be applied conservatively in stands comprised of old trees. Research shows that when natural surface fire has been excluded from stands of old trees for long periods, then it is important to reintroduce fire carefully to avoid increased levels of overstory mortality related mostly to fine-root damage (Swezy and Agee 1991, Ritchie et al. 2008).

SE → SE → OFSS

Stands in stem exclusion structure will be thinned and later underburned, which will keep stands from transitioning to an understory reinitiation stage. If stands were thinned only, without follow-up underburning or noncommercial thinning, then they could be expected to transition to an understory reinitiation stage, with small trees eventually occupying the growing space created by thinning. However, with the follow-up underburning and noncommercial thinning, stands can be expected to be maintained in a stem exclusion stage, eventually transitioning to an old forest single stratum stage as the trees grow larger.

The effectiveness of using forest management to initiate and sustain a transitional progression from stem exclusion to old forest single stratum was noted specifically in a recent study involving the Blue Mountains: “thinning to maintain density targets [such as those provided by Cochran et al. 1994 and Powell 1999] converted the stem exclusion stage to single-stratum old forest” (Barbour et al. 2005).

UR → SE → OFSS

Stands in the understory reinitiation stage will be thinned, with follow-up underburning and noncommercial thinning. This treatment will initially move the stand to a stem exclusion stage, which will eventually transition to an old forest single stratum stage as the trees grow larger.

A key feature of this transition is near-term application of silvicultural treatments (upland-forest thinning and noncommercial thinning) to create additional growing space and a stem exclusion stand structure, which then allows the remaining trees to grow faster and transition into the old-forest diameter class (≥

21" dbh) more quickly than if thinning had not been completed (the number of trees greater than or equal to 21 inches in diameter are a primary consideration when calculating the old forest structural stages).

Once again, repeated application of prescribed fire (underburning) is necessary to keep this transition viable for the long term – without underburning, the middle stage of this sequence (SE) will transition back to the UR stage.

SI → SI → SE

Some stands currently in the initiation phase will have prescribed fire (underburning) treatments to reduce shrub density (such as snowbrush ceanothus) and promote establishment of early-seral tree species. In some portions of the 1996 Wheeler Point fire (see figs. 2, 9, 18), where large amounts of the 'bareground' and stand initiation structures exist, limited amounts of reforestation will occur by out-planting tree seedlings into suitable microsites, thereby augmenting the meager levels of existing tree regeneration.

Due to the long-term nature of these vegetation management activities, and due to the uncharacteristic regeneration niches created by the Wheeler Point fire (especially when compared with regeneration niches created by properly functioning dry-forest disturbance processes), no immediate (near-term) change in structure will occur with this transition sequence (this is the reason that SI transitions to more SI, rather than to a different structural stage).

Stand Density

High → Low → Low (65%) / Moderate (25%) / High (10%)

Moderate → Low → Low

Low → Low → Low

All stands proposed for treatment are currently classified as high or moderate density. Thinning treatments will have an immediate effect on stand density, and they are prescribed in such a way that residual density occurs within management guidelines expressed by plant association (Cochran et al. 1994, Powell 1999). This approach has the effect of moving high and moderate density stands to the low density classification. Follow-up treatments such as prescribed fire (underburning) and noncommercial thinning helps maintain stand density within the prescribed management zone.

Based on professional experience and FVS modeling results, it is expected that implementing the thinning activity and subsequent repeated underburns, 65% of high-density stands will have low density in 50 years, 25% will have moderate density, and 10% will have high density. Some of the transition from high to moderate (instead of low) density is intentional, and it is designed to address wildlife habitat connectivity objectives (as described later in section entitled "Consistency of Proposed Silvicultural Activities with Eastside Screens Forest Plan Amendment").

Based on the variable-density thinning and ICO prescriptions, approximately 10-15% of each upland-forest commercial thinning unit will remain untreated as 'skips'. The skipped areas can be expected to remain in a high density condition, so they will provide approximately 10% of the high density category.

Forest Cover Type

Grand fir → Ponderosa pine → Ponderosa pine

Proposed treatment stands with a grand fir cover type (currently) will transition toward a ponderosa pine cover type. Much of the grand fir will be removed from the stand, leaving ponderosa pine or Douglas-fir as residual species; their removal helps create growing space and site conditions suitable for ponderosa pine regeneration by providing intermittent patches of exposed mineral soil as a regeneration substrate.

Grand fir stands on the dry-forest biophysical environment (Dry UF PVG) have a grand fir cover type due to a lack of disturbance (e.g., fire exclusion), and to the effects of historical timber harvest practices. Thinning and follow-up prescribed fire (underburning) will help these stands transition back to a ponderosa pine cover type, with some areas of Douglas-fir retained as well. Some units have large (≥ 21" dbh) and old (≥ 150 years abh) grand fir, in addition to ponderosa pine and Douglas-fir, and they will still contain a good representation of grand fir after treatment.

Ponderosa pine → Ponderosa pine → Ponderosa pine

Stands where ponderosa pine is currently the majority or plurality tree species will continue to be dominated by ponderosa pine under any of the proposed treatments.

Douglas-fir → Ponderosa pine → Ponderosa pine

Many Douglas-fir stands in Kahler's dry-forest biophysical environment (Dry UF PVG) have a Douglas-fir cover type due to a lack of disturbance (e.g., fire exclusion), and to the effects of historical timber harvest practices that preferentially removed ponderosa pine and left other species such as Douglas-fir and grand fir. Upland-forest thinning, particularly when combined with underburning, can be expected to transition these Douglas-fir stands back to a ponderosa pine cover type.

A few stands have scattered large Douglas-fir, or areas where there is little remnant ponderosa pine. These stands can be expected to remain Douglas-fir stands, although thinning-created openings (referred to as 'gaps' in the variable-density thinning and ICO variants), particularly when combined with underburning, will contribute to varying levels of ponderosa pine recruitment within these stands.

FVS modeling was also used to examine how forest vegetation would develop in the absence of any near-term treatment. This information is required for predicting vegetation transitions for the No Action alternative (alternative 1). Table 19 provides examples of No-Action vegetation transitions.

Table 19: Cover type transitions for 'with and without' treatment scenarios

Unit	Existing Cover Type	Cover Type in 2065 Without Treatment	Cover Type in 2065 With Treatment
15	Grand fir	Grand fir	Ponderosa Pine
27	Ponderosa Pine	Ponderosa Pine	Ponderosa Pine
29	Ponderosa Pine	Ponderosa Pine	Ponderosa Pine
50a	Grand fir	Grand fir	Grand fir
57	Douglas-fir	Grand fir	Ponderosa Pine

Notes: This information is based on examination of the trees per acre information in the simulation results, not on interpretation of timber volume results.

Scale of Analysis

Geographical Context for Effects Analysis

The geographical context for estimating direct effects is suitable, National Forest System (NFS) lands located within the Kahler forest vegetation affected environment (fig. 6, and tables 6 and 15) <u>and</u> directly affected by implementation of forest vegetation activities (upland-forest commercial thinning, upland forest noncommercial thinning, etc.; see table 1) included in an alternative.

Silvicultural activities included in alternative 2 (proposed action) would directly affect approximately 12,220 acres of the affected environment (table 6); silvicultural activities included in alternative 3 would directly affect approximately 11,540 acres of the affected environment (table 6).

The geographical context for estimating indirect effects is suitable, NFS lands located within the forest vegetation affected environment (fig. 6, and tables 6 and 15). Analysis of indirect effects considers the influence of direct effects occurring at a different time or place than the direct effects themselves.

The geographical context for estimating cumulative effects is the forest vegetation affected environment (app. 31,120 acres) located in the Kahler planning area (app. 32,840 acres). There is no need to extend the cumulative effects analysis area beyond the Kahler affected environment because forest vegetation conditions of the affected environment are common and widely distributed throughout the Kahler planning area, the Heppner Ranger District in which it occurs, the Umatilla National Forest containing the Heppner RD (Christensen et al. 2007), and the Blue Mountains ecoregion containing the Umatilla NF (Rainville et al. 2008). This cumulative effects area is also well aligned with HRV requirements (15,000-35,000 acres).

Temporal Context for Effects Analysis

The temporal context for evaluating environmental effects considers past, present, and reasonably foreseeable actions in the Kahler planning area, as described below.

- Past actions influenced existing conditions in the planning area. A database was developed by using Most Similar Neighbor imputation procedures to characterize existing vegetation conditions (Justice 2014). Existing vegetation conditions are current as of 2012. Field reviews found that existing conditions in the planning area appropriately reflect past changes resulting from three silvicultural activities: timber harvest, tree planting, and noncommercial thinning (figs. 8 and 15). Existing conditions also reflect the historical influence of wildfire, insect and disease activity (fig. 7), fire exclusion, and other changes caused by non-silvicultural factors.
- Present (ongoing) actions were considered when evaluating cumulative effects. Two present actions could potentially affect forest vegetation conditions in the Kahler planning area: (1) a District-wide noncommercial thinning project and (2) the Long Prairie Fuels Reduction project (fig. 15). Both of these projects were authorized by categorical exclusion (Decision Memo) in 2009 (Mafera 2009a, 2009b); they include noncommercial thinning activities designed to increase residual tree vigor, address dwarf-mistletoe and other insect or disease issues, and reduce ladder fuels. The cumulative effects analysis also explicitly considers direct and indirect effects expected from implementation of silvicultural activities included in Kahler alternatives 2 and 3.
  Finding: I reviewed District-wide noncommercial thinning CE materials (Decision Memo and associated documents), and I find the noncommercial thinning treatment specifications to be similar to treatments included in alternatives 2 and 3 of the Kahler Dry Forest Restoration Project.
  Finding: I reviewed Long Prairie Fuels Reduction CE materials (Decision Memo and associated documents), and I find the treatment specifications for noncommercial thinning and prescribed fire to be similar to treatments included in alternatives 2 and 3 of the Kahler Dry Forest Restoration Project. Therefore, noncommercial thinning and prescribed fire treatments authorized by CE represent incremental actions that, in my judgment, are fully responsive to the Kahler project's purpose and need.
- Reasonably foreseeable actions were considered for the cumulative effects analysis. Actions are considered to be reasonably foreseeable if Forest Service planning activities (scoping, etc.) have been initiated for them. Based on a review of the Forest's schedule of proposed actions (SOPA), no reasonably foreseeable actions potentially affecting vegetation conditions in the Kahler planning area are anticipated over the next 5 years.
- For the purpose of cumulative effects analysis, future vegetation conditions incorporate direct and indirect effects from three sources: (1) implementation of proposed activities included in Kahler action

alternatives (alternatives 2 and 3); (2) present (ongoing) activities; and (3) implementation of reasonably foreseeable actions. The timeframe for cumulative effects analysis is a 50-year period because it is my judgment that this period adequately reflects the response of species composition, forest structure, and stand density to silvicultural manipulations.

Alternative 1 – No Action

By definition, direct and indirect effects (40 CFR 1508.8), and cumulative effects (40 CFR 1508.7) result from the proposed action, and thus are not germane to the No Action alternative. However, the No Action alternative allows previously approved (on-going) activities to proceed, but none of the silvicultural activities included in the Kahler proposed action will be implemented under alternative 1.

Because alternative 1 does not include any silvicultural activities beyond those previously approved (ongoing), it is not expected to result in direct or indirect effects on species composition, forest structure, and stand density. Since there are no direct or indirect effects of implementing this alternative on the forest vegetation indicators, there are also no cumulative effects associated with alternative 1.

The concept of this alternative is that ongoing disturbance and succession processes influencing vegetation conditions in the Kahler planning area will continue without human interference. If needs described earlier in this report (see Introduction section, page 1) could be addressed by alternative 1 – a questionable assumption – it will occur as a result of vegetation changes induced by natural ecosystem processes, not as a result of implementing silvicultural activities specifically directed at modifying composition, structure, and density in the Kahler planning area.

Therefore, this section estimates the forest vegetation conditions that will develop on the affected environment from not implementing the proposed action. Just like for the action alternatives, analysis of the No Action alternative is based on an examination of species composition, forest structure, and stand density. The analysis presented in this section is possible because, as described in the Effects Analysis section, FVS modeling was used to examine vegetation development relationships in the absence of future vegetation treatments.

Species Composition (Forest Cover Types)

Table 20 shows the estimated impact of No Action on species composition (forest cover type) in 2065. The scale context for table 20 is the same 'footprint' area as the Kahler proposed action (PA) (app. 12,220 acres). Table 20 addresses this question: what will happen to species composition in 50 years if the Kahler PA is not implemented in 2015?

Table 20 shows that without implementing the silvicultural activities included in the Kahler PA, we can expect the following species composition outcomes in the next 50 years:

1) Douglas-fir and grand fir almost double, or more than double, in area.
2) Some shrub-steppe nonforest environments with high value to native ungulates transition to a lower-value (for wildlife) western juniper woodland type.
3) Ponderosa pine, a keystone plant species on dry-forest biophysical environments, is reduced by more than two-thirds in area.
4) The small amounts of quaking aspen and western larch currently found in the proposed-action footprint area will disappear entirely, causing a reduction in vegetation biodiversity.

Table 21 shows the estimated impact, in 2065, of No Action on species composition (forest cover type) for the Kahler forest vegetation affected environment (AE). Table 21 addresses this question: if the Kahler PA is not implemented in 2015, and considering natural succession for areas outside of the Kahler PA footprint, what will happen to species composition for the forest vegetation AE by 2065?

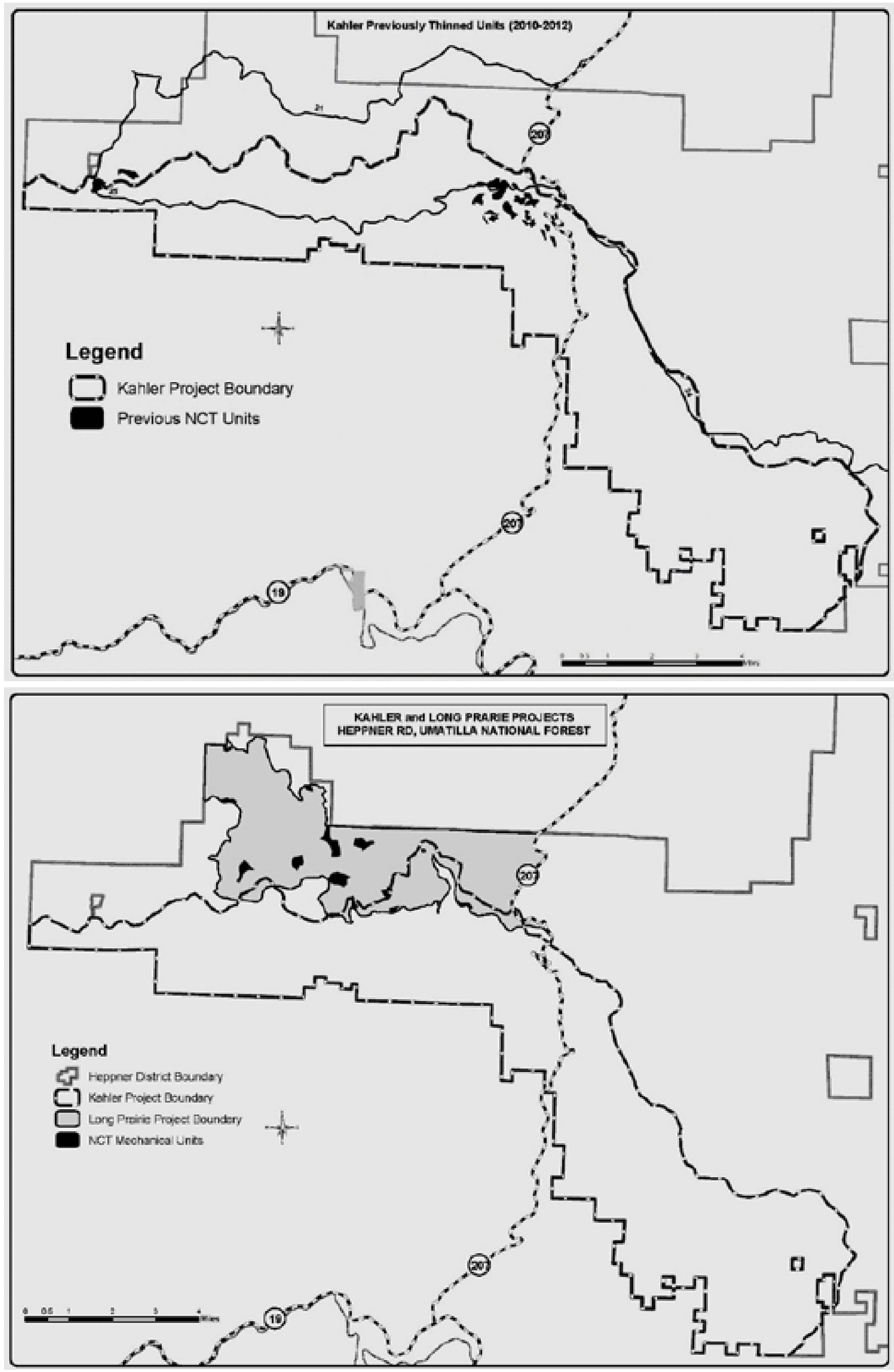


Figure 15 – Present (ongoing) actions in the Kahler planning area – a District-wide noncommercial thinning project (top), and the Long Prairie fuels reduction project (bottom). Both projects were authorized by categorical exclusion (Decision Memo) in 2009.

Table 20: Estimated impact of alternative 1 (No Action) on species composition

	No Action (2012)		No Action (2065)	
Forest Cover Type	**Acres**	**Percent**	**Acres**	**Percent**
Douglas-fir	3,960	32	7,780	64
Engelmann spruce	40	< 1	40	< 1
Grand fir	720	6	1,930	16
Nonforest	130	1	0	0
Ponderosa pine	7,120	58	2,100	17
Quaking aspen	10	< 1	0	0
Western juniper	230	2	360	3
Western larch	10	< 1	0	0
Total	12,220	30	12,210	100

Notes: Summarized from the Kahler vegetation database, but only for the portion of the affected environment applicable to the proposed action (alternative 2). This analysis reflects the estimated results of not implementing vegetation activities on the footprint area of the Kahler proposed action (app. 12,220 acres of the Kahler affected environment).

Table 21: Estimated impact of alternative 1 (No Action) on the affected environment's species composition

	No Action (2012)		No Action (2065)	
Forest Cover Type	**Acres**	**Percent**	**Acres**	**Percent**
Douglas-fir	7,760	25	15,730	51
Engelmann spruce	60	< 1	60	< 1
Grand fir	1,440	5	3,520	11
Lodgepole pine	10	< 1	0	0
Nonforest	3,840	12	3,710	12
Ponderosa pine	17,220	55	7,230	23
Quaking aspen	20	< 1	0	0
Western juniper	740	2	870	3
Western larch	30	< 1	0	0
Total	31,120	100	31,120	100

Notes: Summarized from the Kahler vegetation database for the affected environment (approximately 31,120 acres; see table 6), and reflecting the estimated results of not implementing vegetation activities associated with the proposed action on approximately 12,220 acres of the Kahler affected environment.

Table 21 shows that without implementing the silvicultural activities included in the Kahler PA, we can expect the following species composition outcomes for the Kahler forest vegetation AE by 2065:

1) Douglas-fir more than doubles in area.
2) Grand fir more than doubles in area.
3) Some shrub-steppe nonforest environments with high value to native ungulates transition to a lower-value (for wildlife) western juniper woodland type.
4) Ponderosa pine, a keystone plant species on dry-forest biophysical environments, is reduced in area by about 60 percent.
5) The small amounts of quaking aspen and western larch currently found in the AE will disappear entirely, causing a reduction in vegetation biodiversity.

This forest vegetation analysis is informed by an analytical technique referred to as the Historical Range of Variation (HRV) (see Historical Range of Variation Analytical Technique section on page 17). HRV is used to examine the consequences of not implementing the proposed action on species composition.

Table 22, which shows the results of an HRV analysis for species composition as it is estimated to exist in 2065, suggests that without implementing silvicultural activities included in the Kahler PA, we can expect Douglas-fir to be substantially over-represented on dry-forest sites, grand fir to be slightly over-represented on dry-forest sites, ponderosa pine to be substantially under-represented on dry-forest sites, and western larch to be slightly under-represented on dry-forest sites. In the absence of treatment (no action), only western juniper is estimated to occur within its historical range in 2065.

Table 22 discloses vegetation trends to be expected from No Action – early-seral species composition (the ponderosa pine and western larch cover types on dry-forest sites) are replaced with late-seral cover types (Douglas-fir and grand fir) because thinning and prescribed fire are not being used to periodically adjust composition. Since it is assumed that wildfire continues to be suppressed for the No Action alternative, then this keystone ecosystem process is also not available to function as a natural adjustment agent.

Table 22: HRV analysis for forest cover types of the forest vegetation affected environment (alternative 1)

	DRY UPLAND FOREST PVG			
	Historical Range		No Action (2065)	
Forest Cover Type	Percent	Acres	Percent	Acres
Douglas-fir	5-20	1,350-5,400	58	15,720
Grand fir	1-10	270-2,700	12	3,280
Lodgepole pine	0	0	0	0
Ponderosa pine	50-80	13,500-21,600	27	7,230
Subalpine fir and spruce	0	0	0	0
Western juniper	0-5	0-1,350	3	740
Western larch	1-10	270-2,700	0	0
Western white pine	0-5	0-1,350	0	0
Whitebark pine	0	0	0	0
Total			100	26,970

Notes: No Action amounts are taken from the Kahler vegetation database. Gray shading indicates cover types that are above or below the historical range of variation. Historical ranges are taken from Martin (2010). Lodgepole pine, subalpine fir and spruce, and whitebark pine have zeroes for historical ranges because they would not be expected to occur on the dry upland forest biophysical environment. This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2); it does not include Dry UF acreage located outside of the affected environment but within the Kahler planning area, or Moist UF PVG or nonforest acreage.

Forest Structure (Forest Structural Stages)

Table 23 shows the estimated impact of No Action on forest structure (forest structural stage) in 2065. The scale context for table 23 is the same ‘footprint’ area as the Kahler PA (app. 12,220 acres). Table 23 addresses this question: what will happen to forest structure in 50 years if the Kahler PA is not implemented in 2015?

Table 23 shows that without implementing the silvicultural activities included in the Kahler PA, we can expect the following forest structure outcomes by 2065:

1) Old forest multi-strata almost triples in area.

2) Old forest single stratum disappears from the PA footprint area.
3) Stem exclusion declines to less than 20% of its current abundance.
4) Stand initiation disappears from the PA footprint area.
5) Understory reinitiation increases by almost 50% in area.

Table 23: Estimated impact of alternative 1 (No Action) on forest structure

Forest Structural Stage	No Action (2012)		No Action (2065)	
	Acres	Percent	Acres	Percent
SI: Stand Initiation	160	1	0	0
SE: Stem Exclusion	4,510	37	830	7
UR: Understory Reinitiation	4,900	40	7,080	58
OFSS: Old Forest Single Stratum	1,090	9	0	0
OFMS: Old Forest Multi-Strata	1,430	12	4,180	34
Nonforest	130	1	130	1
Total	12,220	100	12,220	100

Notes: Summarized from the Kahler vegetation database, but only for the affected environment portion included in the proposed action (alternative 2). Thus, this analysis reflects the estimated results of not implementing activities associated with the proposed action on approximately 12,220 acres of the Kahler affected environment.

Table 24 shows the estimated impact, in 2065, of No Action on forest structure (forest structural stages) for the Kahler forest vegetation AE. Table 24 addresses this question: if the Kahler PA is not implemented in 2015, and considering natural succession for areas outside of the Kahler PA footprint, what will happen to forest structure for the forest vegetation AE by 2065?

Table 24 shows that without implementing the silvicultural activities included in the Kahler PA, we can expect the following forest structure outcomes for the Kahler forest vegetation AE by 2065:
1) Old forest multi-strata almost triples in area.
2) Old forest single stratum disappears from the AE area.
3) Stem exclusion declines by more than 50%.
4) Stand initiation declines by about 35%.
5) Understory reinitiation increases by about 40%.

Table 24: Estimated impact of alternative 1 (No Action) on the affected environment's forest structure

Forest Structural Stage	No Action (2012)		No Action (2065)	
	Acres	Percent	Acres	Percent
SI: Stand Initiation	5,140	17	3,360	11
SE: Stem Exclusion	9,330	30	4,360	14
UR: Understory Reinitiation	8,690	28	12,210	39
OFSS: Old Forest Single Stratum	1,550	5	0	0
OFMS: Old Forest Multi-Strata	2,580	8	7,360	24
Nonforest	3,840	12	3,840	12
Total	31,130	100	31,130	100

Notes: Summarized from the Kahler vegetation database for the affected environment (approximately 31,120 acres; see table 6), and reflecting the estimated results of not implementing activities associated with the proposed action on approximately 12,220 acres of the Kahler affected environment.

This forest vegetation analysis is informed by an analytical technique referred to as the Historical Range of Variation (HRV) (see Historical Range of Variation Analytical Technique section on page 17). HRV is used to examine the consequences of not implementing the proposed action on forest structure.

Table 25, which shows the results of an HRV analysis for forest structure as it is estimated to exist in 2065, suggests that without implementing silvicultural activities included in the Kahler proposed action, we can expect: (1) the old forest multi-strata and understory reinitiation structural stages to be substantially over-represented on dry-forest sites; (2) the old forest single stratum stage to be substantially under-represented on dry-forest sites; and (3) the stand initiation stage to be slightly under-represented on dry-forest sites. In the absence of treatment (no action), only the stem exclusion structural stage is estimated to occur within its historical range in 2065.

Table 25 discloses vegetation trends that are not unexpected from a No Action scenario – late-seral, multi-cohort (multi-layer) stand conditions (as represented by the OFMS and UR forest structural stages) are replacing the historically dominant early-seral, single-cohort (single-layer) forest structures (the OFSS, SE, and SI stages). Transitions from early-seral structures to late-seral structures are associated with the No Action alternative because thinning and prescribed fire are not being used to periodically interrupt this natural successional progression. Since an assumption is that wildfire continues to be suppressed for the No Action alternative, then a keystone ecosystem process referred to as short-interval surface fire is not available to function as a natural thinning agent.

Table 25: HRV analysis of forest structural stages for forest vegetation affected environment (alternative 1)

	DRY UPLAND FOREST PVG			
	Historical Range		No Action (2065)	
Forest Structural Stage	Percent	Acres	Percent	Acres
SI: Stand Initiation	15-25	4,050-6,750	12	3,360
SE: Stem Exclusion	10-20	2,700-5,400	16	4,360
UR: Understory Reinitiation	5-10	1,350-2,700	45	12,040
OFSS: Old Forest Single Stratum	40-60	10,800-16,200	0	0
OFMS: Old Forest Multi-Strata	5-15	1,350-4,050	27	7,230
Total			100	26,990

Notes: Existing amounts are taken from the Kahler vegetation database. Gray shading indicates cover types that are above or below the historical range of variation. Historical ranges are taken from Martin (2010). Lodgepole pine, subalpine fir and spruce, and whitebark pine have zeroes for historical ranges because they would not be expected to occur on the dry upland forest biophysical environment. This analysis includes unsuitable NFS land proposed for treatment (see table 6, footnote 2); it does not include Dry UF acreage located outside of the affected environment but within the Kahler planning area, or Moist UF PVG or nonforest acreage.

Stand Density (Stand Density Classes)

Table 26 shows the estimated impact of No Action on stand density (stand density classes) in 2065. The scale context for table 26 is the same 'footprint' area as the Kahler PA (app. 12,220 acres). Table 26 addresses this question: what will happen to stand density in 50 years if the Kahler PA is not implemented in 2015?

Table 26 shows that without implementing the silvicultural activities included in the Kahler PA, we can expect the following stand density outcomes by 2065:

1) Low stand density declines to less than 1% of the PA footprint area.
2) Moderate stand density declines to about 25% of its original area.

3) High stand density increases by slightly more than 40%.

Table 26: Estimated impact of alternative 1 (No Action) on stand density

	No Action (2012)		No Action (2065)	
Stand Density Class	**Acres**	**Percent**	**Acres**	**Percent**
Low	1,800	15	30	< 1
Moderate	2,150	18	520	4
High	8,140	67	11,540	94
Nonforest	130	1	130	1
Total	12,220	101	12,220	99

Notes: Summarized from the Kahler vegetation database, but only for the portion of the affected environment applicable to the proposed action (alternative 2). This analysis reflects the estimated results of not implementing vegetation activities associated with the proposed action on approximately 12,220 acres of the Kahler affected environment.

Table 27 shows the estimated impact, in 2065, of No Action on stand density (stand density classes) for the Kahler forest vegetation AE. Table 27 addresses this question: if the Kahler PA is not implemented in 2015, and considering natural succession for areas outside of the Kahler PA footprint, what will happen to stand density for the forest vegetation AE by 2065?

Table 27 shows that without implementing the silvicultural activities included in the Kahler PA, we can expect the following stand density outcomes for the Kahler forest vegetation AE by 2065:
1) Both the low and moderate stand density classes decline to less than 40% of their original area.
2) High stand density increases by more than 70% during the 50-year period.

Table 27: Estimated impact of alternative 1 (No Action) on the affected environment's stand density

	No Action (2012)		No Action (2065)	
Stand Density Class	**Acres**	**Percent**	**Acres**	**Percent**
Low	10,190	33	3,950	13
Moderate	4,540	15	1,700	5
High	12,550	40	21,630	70
Nonforest	3,840	12	3,840	12
Total	31,120	100	31,120	100

Notes: Summarized from the Kahler vegetation database for affected environment (approximately 31,120 acres; see table 6), and reflecting the estimated results of not implementing activities associated with the proposed action on approximately 12,220 acres of the Kahler affected environment.

This forest vegetation analysis is informed by an analytical technique referred to as the Historical Range of Variation (HRV) (see Historical Range of Variation Analytical Technique section on page 17). HRV is used to examine the consequences of not implementing the proposed action on stand density.

Table 28 presents the results of an HRV analysis for stand density as it exists in 2065; it suggests that without implementing silvicultural activities in the Kahler proposed action on dry-forest sites, we can expect the low and moderate stand density classes to be substantially under-represented, and high stand density to be substantially over-represented. In the absence of treatment (no action), none of the stand density classes are estimated to occur within their historical ranges in 2065.

Table 28 discloses vegetation trends to be expected from No Action – relatively open stand conditions (low and moderate stand density classes) are replaced with dense stand conditions because thinning and prescribed fire are not being used to periodically reduce density. Since an assumption is that wildfire continues to be suppressed for the No Action alternative, then a keystone ecosystem process referred to as short-interval surface fire is not available to function as a natural thinning agent.

Table 28: HRV analysis of stand density classes for forest vegetation affected environment (alternative 1)

	DRY UPLAND FOREST PVG			
	Historical Range		No Action (2065)	
Stand Density Class	Percent	Acres	Percent	Acres
Low	40-85	10,800-22,950	15	3,950
Moderate	15-30	4,050-8,100	6	1,700
High	5-15	1,350-4,050	79	21,330
Total			100	26,980

Notes: Existing amounts are taken from the Kahler vegetation database. Gray shading indicates cover types that are above or below the historical range of variation. Historical ranges are taken from Martin (2010). Lodgepole pine, subalpine fir and spruce, and whitebark pine have zeroes for historical ranges because they would not be expected to occur on the dry upland forest biophysical environment. This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2); it does not include Dry UF acreage located outside of the affected environment but within the Kahler planning area, or Moist UF PVG or nonforest acreage.

Cumulative Effects

Past actions, including timber harvest (fig. 8), tree planting, and noncommercial thinning, helped create existing conditions in the planning area. Present (ongoing) actions, which includes noncommercial thinning and prescribed fire activities authorized by categorical exclusions in 2009 (fig. 15), will reduce stand density, modify forest structure, and shift species composition in the areas being treated, but recent funding levels suggest that very little actual noncommercial thinning will occur (most likely no more than 100-200 acres per year in the Kahler planning area), reflecting recent budget allocation experience between 2010 and 2014 (and see fig. 15).

No reasonably foreseeable future actions are anticipated for the Kahler planning area over the next five years, as based on a review of the Umatilla National Forest's schedule of proposed actions (SOPA).

Because alternative 1 does not include any silvicultural activities, it is not expected to result in direct or indirect effects on species composition, forest structure, and stand density. Since there are no direct or indirect effects of implementing this alternative on the forest vegetation indicators, there are also no cumulative effects associated with alternative 1.

Species composition, forest structure, and stand density are expected to change in the future under a No Action scenario, but the changes will be unpredictable and derived primarily from natural disturbance and succession processes, not from implementing any of the proposed silvicultural activities (actions).

Since future vegetation change relates primarily to the timing, magnitude, duration, and intensity of disturbance events (including how they are affected by climate change; see pages 71-80), along with limited amounts of change caused by present (ongoing) actions, and because consideration of unpredictable natural change is speculative and beyond the scope of this analysis, no attempt was made to estimate the future effects of disturbance processes.

If none of the silvicultural activities included in the proposed action will be implemented to move existing conditions closer to desired conditions, then forest vegetation within the planning area will remain overly dense (table 28) and continue to be dominated by mid- and late-seral stages of species composition (particularly the Douglas-fir forest cover type) (table 22). Old forest (late-old) structure on dry-forest sites will continue to be marginal or deficient because proposed activities will not be used to reduce the stem exclusion and understory reinitiation structural stages, and thereby increase the future representation of old forest single stratum structural stage, which is substantially deficient at this time (table 25).

Alternative 2 – Proposed Action

Direct and Indirect Effects for Alternative 2

Direct effects are assumed to occur only on the portion of the forest vegetation affected environment included in alternative 2 (comprising app. 12,220 acres; see table 6).

Three indicators are used to present pretreatment and post-treatment trends for vegetation conditions: forest cover types, forest structural stages, and stand density classes. Direct effects on cover types, structural stages, and density classes are a consequence of implementing the forest vegetation management activities described in table 1 of this report.

Indirect effects consider the impact of direct effects on the larger forest vegetation affected environment in which they occur – direct effects resulting from implementing alternative 2 (app. 12,220 acres) are applied to the affected environment (app. 31,120 acres) to estimate indirect effects. Three indicators are used to analyze pre-treatment and post-treatment trends for indirect effects: species composition (forest cover types), forest structural stages, and stand density classes.

Species Composition (Forest Cover Types)

Species composition, as represented by forest cover types, is expected to change in response to implementation of silvicultural activities proposed for alternative 2 (see the post-implementation columns in table 29). Most of the forest cover types affected by implementation of alternative 2 are late-seral (grand fir and Douglas-fir on upland-forest sites; western juniper on shrub-steppe environments), and they are reduced as a direct effect of implementation; the primary early-seral cover type (ponderosa pine) is increased as a consequence of implementing this alternative. Thinning and prescribed fire are expected to increase the reproductive output of ponderosa pine (Peters and Sala 2008), so these treatments will contribute to future regeneration of this species and an associated increase in the ponderosa pine cover type.

The post-implementation changes in forest cover types (2015) are viewed as beneficial because they directly support the Kahler project's purpose and need (e.g., "restore and promote open stands of old forest dominated by ponderosa pine, thereby moving the area toward its historical range in structure, density, and species composition").

By 2065, the near-term implementation effects of alternative 2 are not maintained – Douglas-fir and grand fir both increase when compared with their 2015 levels, while ponderosa pine is decreased from its 2015 (post-implementation) level.

Table 30 shows that the direct effects of implementing alternative 2 has an obvious, near-term influence on species composition when the effects are expressed for the entire forest vegetation affected environment (AE). As a result of implementing alternative 2, the representation of three cover types is reduced from pre-treatment levels (Douglas-fir, grand fir, and western juniper). Representation of ponderosa pine increases for the AE – it transitions from 55% (pre-treatment) to 69% of the AE (post-treatment).

Table 29: Direct effects for species composition for alternative 2 (proposed action)

Forest Cover Type	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
	Acres	Percent	Acres	Percent	Acres	Percent
Douglas-fir	3,960	32	580	5	2,120	17
Engelmann spruce	40	< 1	40	< 1	40	< 1
Grand fir	720	6	150	1	330	3
Nonforest	130	1	130	1	130	1
Ponderosa pine	7,120	58	11,290	92	9,570	78
Quaking aspen	10	< 1	10	< 1	10	< 1
Western juniper	230	2	0	0	0	0
Western larch	10	< 1	10	< 1	10	< 1
Total	12,220	30	12,210	100	12,210	100

Notes: Summarized from the Kahler vegetation database, but only for the portion of the affected environment to be modified by alternative 2 – approximately 12,220 acres.

By 2065, the near-term beneficial implementation effects of alternative 2 on the forest vegetation AE are not maintained. Douglas-fir and grand fir both rebound to an extent where their 2065 acreage exceeds what it was in 2012. Ponderosa pine is also reduced to levels below its 2012 baseline level.

The 2065 outcome is based on two factors:

1) Natural succession continues to cause substantial vegetation change on the portion of the AE not affected by implementation of alternative 2.
2) Acres treated by alternative 2 cannot be sustained in their post-treatment (2015) condition without follow-up maintenance treatments (thinning and prescribed fire) during the 50-year period.

Note that future maintenance treatments are not explicitly assumed for this analysis as they might be considered speculative; thinning and prescribed fire may occur during this 50-year timeframe (Marshall 2014), and they would be largely successful at preventing a return to pre-implementation conditions (Ritchie et al. 2007).

Table 30: Indirect effects for species composition for alternative 2 (proposed action)

Forest Cover Type	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
	Acres	Percent	Acres	Percent	Acres	Percent
Douglas-fir	7,760	25	4,380	14	10,070	32
Engelmann spruce	60	< 1	60	< 1	60	< 1
Grand fir	1,440	5	880	3	1,910	6
Lodgepole pine	10	< 1	10	< 1	0	0
Nonforest	3,840	12	3,840	12	3,840	12
Ponderosa pine	17,220	55	21,390	69	14,700	47
Quaking aspen	20	< 1	20	< 1	10	< 1
Western juniper	740	2	510	2	510	2
Western larch	30	< 1	30	< 1	10	< 1
Total	31,120	100	31,120	100	31,110	100

Notes: Summarized from the Kahler vegetation database for the affected environment (approximately 31,120 acres; see table 6), and reflecting the direct effects of implementing alternative 2 on approximately 12,220 acres of the Kahler affected environment.

This forest vegetation analysis is informed by an analytical technique referred to as the Historical Range of Variation (HRV) (see Historical Range of Variation Analytical Technique section on page 17). HRV is used to examine the consequences of implementing the proposed action on species composition.

Table 31 presents results of an HRV analysis for species composition as it exists in 2015 (post-implementation) and 2065 (reflecting 50 years of vegetation development without any future retreatment of the 2012 acreage); it suggests that alternative 2 was extremely effective at addressing the Kahler purpose and need with respect to species composition – immediately after treatment (2015), all of the forest cover types were within their ranges of variation except for western larch, which was slightly below the lower limit of its range.

By 2065, Table 31 shows that dry-forest cover types are still mostly within their ranges of variation with the exception of Douglas-fir, which is substantially above the upper limit of its range.

Table 31: HRV analysis of forest cover types for forest vegetation affected environment (alternative 2)

	DRY UPLAND FOREST POTENTIAL VEGETATION GROUP					
	Historical Range		Post-Treatment (2015)		Post-Treatment (2065)	
Forest Cover Type	Percent	Acres	Percent	Acres	Percent	Acres
Douglas-fir	5-20	1,350-5,400	16	4,310	37	9,990
Grand fir	1-10	270-2,700	3	790	7	1,790
Lodgepole pine	0	0	0	0	0	0
Ponderosa pine	50-80	13,500-21,600	79	21,370	54	14,690
Subalpine fir and spruce	0	0	0	0	0	0
Western juniper	0-5	0-1,350	2	510	2	510
Western larch	1-10	270-2,700	0	0	0	0
Western white pine	0-5	0-1,350	0	0	0	0
Whitebark pine	0	0	0	0	0	0
Total			100	26,980	100	26,980

Notes: Existing amounts are taken from the Kahler vegetation database. Gray shading indicates cover types that are above or below the historical range of variation. Historical ranges are taken from Martin (2010). Lodgepole pine, subalpine fir and spruce, and whitebark pine have zeroes for historical ranges because they would not be expected to occur on the dry upland forest biophysical environment. This analysis includes unsuitable NFS lands proposed for treatment (see table 6, footnote 2). This analysis does not include quaking aspen because no historical range was provided for it in Martin (2010); it also does not include Dry UF acreage located outside of the affected environment but within the Kahler planning area, or Moist UF PVG or nonforest acreage.

Forest Structure (Forest Structural Stages)

Forest structure, represented by using forest structural stages, is expected to change in response to implementation of silvicultural activities for alternative 2 (see the post-implementation column in table 32).

The 2015 (post-implementation) information in table 32 shows two primary changes resulting from implementation of alternative 2:

1) Old forest multi-strata (OFMS) stands receive understory thinning treatments to transform them immediately to the old forest single stratum (OFSS) stage (400 acres of treatment).

2) Understory reinitiation (UR) stands are thinned to remove ladder fuels and increase residual tree growth and vigor – this treatment transitions UR stands to the stem exclusion (SE) stage.

The post-implementation changes in forest structure (2015) are viewed as beneficial because they directly support the Kahler project's purpose and need (e.g., "restore and promote open stands of old forest dominated by ponderosa pine, thereby moving the area toward its historical range in structure, density, and species composition").

Why was a transition from UR to SE an objective of silvicultural activities for alternative 2? The answer relates to prescribed fire and its role in establishing and maintaining the OFSS structural stage.

Prescribed fire (underburning) emulates a keystone disturbance process for dry-forest sites – low-severity, high-frequency surface fire occurring on a cycle of 5-20 years. By thinning UR stands, the lower cohort (layer) of trees is removed, and this lower cohort functions as ladder fuel. Without removing ladder fuel first, it is difficult or impossible to safely implement prescribed fire on these sites. After the ladder fuels have been removed, the proper structural stage assignment for these stands is SE.

The SE structure in this scenario functions as an intermediate stage on a successional trajectory culminating in stable and persistent OFSS (but only if it is maintained with frequent underburning). Overstory trees in an SE stand are too small to be considered for old forest, but they are large enough to be fire resistant, particularly when they are not adjoined by ladder fuels.

After thinning transforms UR to open SE, then prescribed fire can safely be applied (every 10-20 years) to reduce surface fuels, cycle nutrients, and manage future ingrowth of late-seral species, particularly Douglas-fir and grand fir. In other words, thinning creates a post-implementation structural configuration (SE and OFSS) compatible with the project's purpose and need, but prescribed fire is crucial for maintaining these structures through time (Ritchie et al. 2007).

The ultimate result of this treatment regimen, and its resulting structural progression, is illustrated well in table 32 – by 2065, 86% of the Kahler proposed action acreage supports the OFSS structural stage, and the SE stage has all but disappeared by then because most of it transitioned to OFSS.

Table 32: Direct effects for forest structure for alternative 2 (proposed action)

Forest Structural Stage	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
	Acres	Percent	Acres	Percent	Acres	Percent
SI: Stand Initiation	160	1	160	1	0	0
SE: Stem Exclusion	4,510	37	7,470	61	160	1
UR: Understory Reinitiation	4,900	40	1,940	16	0	0
OFSS: Old Forest Single Stratum	1,090	9	1,490	12	10,550	86
OFMS: Old Forest Multi-Strata	1,430	12	1,030	8	1,380	11
Nonforest	130	1	130	1	130	1
Total	12,220	100	12,220	99	12,220	99

Notes: Summarized from the Kahler vegetation database, but only for the portion of the affected environment to be modified by alternative 2 – approximately 12,220 acres.

Table 33 shows that direct effects of implementing alternative 2 influenced the Kahler affected environment (AE) in 2015 in a similar way as for the Kahler proposed action acreage – the old forest structural stages (OFMS and OFSS) changed by equivalent amounts, the UR stage declines, and the SE stage increases.

By 2065, the near-term beneficial implementation effects of alternative 2 (reflecting the 2015 information in table 33) on the forest vegetation AE are maintained or actually improved:
1) Both of the old forest stages increase.
2) Stem exclusion declines to a moderate proportion of the AE acreage.
3) Stand initiation (SI) declines, reflecting slow but ongoing recovery of the Wheeler Point fire area.
4) Understory reinitiation is maintained at moderate levels.

These findings reflect the overall structural stage situation for the Kahler AE – HRV results (table 34) demonstrate whether the 2015 and 2065 structural stage results are ecologically appropriate.

Table 33: Indirect effects for forest structure for alternative 2 (proposed action)

	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
Forest Structural Stage	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
SI: Stand Initiation	5,140	17	5,130	16	3,360	11
SE: Stem Exclusion	9,330	30	12,840	41	3,690	12
UR: Understory Reinitiation	8,690	28	5,180	17	5,120	16
OFSS: Old Forest Single Stratum	1,550	5	1,950	6	10,550	34
OFMS: Old Forest Multi-Strata	2,580	8	2,180	7	4,570	15
Nonforest	3,840	12	3,840	12	3,840	12
Total	31,130	100	31,120	99	31,130	100

Notes: Summarized from the Kahler vegetation database for the affected environment (approximately 31,120 acres; see table 6), and reflecting the direct effects of implementing alternative 2 on approximately 12,220 acres of the Kahler affected environment.

This forest vegetation analysis is informed by an analytical technique referred to as the Historical Range of Variation (HRV) (see Historical Range of Variation Analytical Technique section on page 17). HRV is used to examine the consequences of implementing the proposed action on forest structure.

Table 34 presents results of an HRV analysis for forest structure as it exists in 2015 (post-implementation) and 2065 (reflecting 50 years of vegetation development without any future retreatment of the 2012 acreage, other than periodic underburning); it suggests that alternative 2 is only moderately effective at addressing the Kahler purpose and need for forest structure – immediately after treatment (2015), the OFSS structural stage is under-represented, whereas the SE and UR stages are both over-represented. But as described above, this result is expected because the predicted increase in SE is only a stepping stone between UR (which is substantially over-represented as a Kahler existing condition – see table 12) and OFSS (which is dramatically under-represented for Kahler – see table 12).

By 2065, Table 34 suggests that the structural stage distribution is worse than it was in 2015 (because more of the 2065 boxes have gray shading than is true for the 2015 boxes). This conclusion is somewhat misleading, however, because close inspection of the 2065 results shows that the OFMS stage is just slightly above HRV (by only 1%), and that the OFSS stage is just slightly below HRV (by only 1%).

Table 34: HRV analysis of forest structural stages for forest vegetation affected environment (alternative 2)

	DRY UPLAND FOREST POTENTIAL VEGETATION GROUP					
	Historical Range		Post-Treatment (2015)		Post-Treatment (2065)	
Forest Structural Stage	Percent	Acres	Percent	Acres	Percent	Acres
SI: Stand Initiation	15-25	4,050-6,750	19	5,130	12	3,360
SE: Stem Exclusion	10-20	2,700-5,400	48	12,850	14	3,690
UR: Understory Reinitiation	5-10	1,350-2,700	19	5,090	18	4,990
OFSS: Old Forest Single Stratum	40-60	10,800-16,200	7	1,950	39	10,510
OFMS: Old Forest Multi-Strata	5-15	1,350-4,050	7	1,960	16	4,440
Total			100	26,980	99	26,990

Notes: Existing amounts are taken from the Kahler vegetation database. Gray shading indicates cover types that are above or below the historical range of variation. Historical ranges are taken from Martin (2010). This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2). This analysis does not include Dry UF acreage located outside of the affected environment but within the Kahler planning area, or Moist UF PVG or nonforest acreage.

Stand Density (Density Classes)

Stand density, as represented by using stand density classes, is expected to change in response to implementation of silvicultural activities proposed for alternative 2 (see the post-implementation column in table 35). Inspection of table 35 quickly shows that the alternative 2 silvicultural activities are expected to transform all of the moderate and high density class to the low density class.

The post-implementation changes in stand density classes (2015) are beneficial because they directly support the Kahler project's purpose and need (e.g., "restore and promote open stands of old forest dominated by ponderosa pine, thereby moving the area toward its historical range in structure, density, and species composition"). Thinnings are also valuable because they reduce the vulnerability of forests to drought and similar climate change impacts (D'Amato et al. 2013).

Reductions in stand density contribute to restoration of non-tree ecosystem components – in fire-suppressed forests (such as those present within the Kahler planning area), shrubs are often shaded out, reducing their size, abundance, and fruit and seed production in low-light understory environments. Stand-density reductions are expected to rejuvenate black hawthorn, serviceberry, snowberry, and other suppressed shrub species associated with dry-forest sites.

By 2065, the near-term (2015) implementation effects of alternative 2 are not maintained – without follow-up thinning treatments during the intervening 50 years, most of the low density class is expected to transition to the moderate density class.

Note that follow-up thinning treatments were not assumed for this analysis as they might be considered speculative; prescribed fire may occur during this 50-year timeframe (Marshall 2014), however, and it will be partially effective at preventing a wholesale transition from low density to moderate density.

Table 35: Direct effects for stand density for alternative 2 (proposed action)

	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
Stand Density Class	Acres	Percent	Acres	Percent	Acres	Percent
Low	1,800	15	12,090	99	300	2
Moderate	2,150	18	0	0	11,790	96

Stand Density Class	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
	Acres	Percent	Acres	Percent	Acres	Percent
High	8,140	67	0	0	0	0
Nonforest	130	1	130	1	130	1
Total	12,220	101	12,220	100	12,220	99

Notes: Summarized from the Kahler vegetation database, but only for the portion of the affected environment to be modified by alternative 2 – approximately 12,220 acres.

Table 36 shows that the direct effects of implementing alternative 2 have a similar influence on the affected environment (AE) in 2015 as they did on the proposed action acreage – the low density class doubled, while the moderate and high density classes declined dramatically.

By 2065, the near-term beneficial implementation effects of alternative 2 (reflecting the 2015 information in table 36) on the Kahler AE are not maintained, as evidenced by the fact that low density declines to a point where it is substantially less than either the moderate or high density classes.

This forest vegetation analysis is informed by an analytical technique referred to as the Historical Range of Variation (HRV) (see Historical Range of Variation Analytical Technique section on page 17). HRV is used to examine the consequences of implementing the proposed action on stand density.

Table 36: Indirect effects for stand density for alternative 2 (proposed action)

Stand Density Class	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
	Acres	Percent	Acres	Percent	Acres	Percent
Low	10,190	33	20,480	66	4,220	14
Moderate	4,540	15	2,400	8	12,970	42
High	12,550	40	4,410	14	10,090	32
Nonforest	3,840	12	3,840	12	3,840	12
Total	31,120	100	31,130	100	31,120	100

Notes: Summarized from the Kahler vegetation database for the affected environment (approximately 31,120 acres; see table 6), and reflecting the direct effects of implementing alternative 2 on approximately 12,220 acres of the Kahler affected environment.

Table 37 presents results of an HRV analysis for stand density as it exists in 2015 (post-implementation) and 2065 (reflecting 50 years of vegetation development without any future retreatment of the 2012 acreage, other than periodic underburning); it suggests that alternative 2 is only moderately effective at addressing the Kahler purpose and need for stand density – immediately after treatment (2015), the low density class, which was predominant historically as evidenced by the historical ranges shown in table 37, is well within its range of variation (and this is certainly a positive outcome of implementing alternative 2), whereas the moderate and high density classes are both outside of their historical ranges (but high is above its range by just 1%).

By 2065, table 37 suggests that follow-up thinning treatments are needed if an objective is to maintain forest vegetation within its historical range of variation for stand density – all three of the density classes are outside of their historical ranges.

Note that follow-up thinning treatments were not assumed for this analysis as they might be considered speculative; prescribed fire may occur during this 50-year timeframe (Marshall 2014), however, and it will be partially effective at preventing a progression from low density back to moderate or high density conditions (Ritchie et al. 2007).

Table 37: HRV analysis of stand density classes for forest vegetation affected environment (alternative 2)

	DRY UPLAND FOREST POTENTIAL VEGETATION GROUP					
	Historical Range		Post-Treatment (2015)		Post-Treatment (2065)	
Stand Density Class	Percent	Acres	Percent	Acres	Percent	Acres
Low	40-85	10,800-22,950	75	20,320	16	4,220
Moderate	15-30	4,050-8,100	9	2,380	48	12,820
High	5-15	1,350-4,050	16	4,280	37	9,940
Total			100	26,980	101	26,980

Notes: Existing amounts are taken from the Kahler vegetation database. Gray shading indicates cover types that are above or below the historical range of variation. Historical ranges are taken from Martin (2010). This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2). This analysis does not include Dry UF acreage located outside of the affected environment but within the Kahler planning area, or Moist UF PVG or nonforest acreage.

Project Design Features and Mitigation Measures

Project design features pertaining to silvicultural activities and upland-forest treatments are provided in a separate Kahler environmental assessment document containing design elements for all resource areas. The silviculture design features are contained in a section called ‘Vegetation’.

Cumulative Effects

Past actions, including timber harvest (fig. 8), tree planting, and noncommercial thinning, helped create existing conditions in the planning area. Silvicultural activities associated with alternative 2 are designed to address the project’s purpose and need by helping to move species composition, forest structure, and stand density back within their historical ranges of variability, which is also expected to improve forest health, vegetation vigor, and ecosystem resilience to fire, insects, and disease.

Present (ongoing) actions include noncommercial thinning and prescribed fire activities authorized by categorical exclusions (CE) in 2009; some of the CE-authorized noncommercial thinning occurred in the Kahler planning area from 2010 to 2012 (fig. 15). Noncommercial thinning specifications for the District-wide noncommercial thinning CE were designed to address similar issues and concerns as those influencing the Kahler Dry Forest Restoration project. Therefore, they represent incremental actions (beyond the proposed silvicultural activities) that are also responsive to the Kahler project’s purpose and need.

No reasonably foreseeable future actions are anticipated for the Kahler planning area over the next five years, as based on a review of the Umatilla National Forest’s schedule of proposed actions (SOPA).

When considering direct and indirect effects of the project’s proposed silvicultural activities on species composition (table 31), forest structure (table 34), and stand density (table 37), and when evaluating how direct and indirect effects of past actions, present (ongoing) actions, proposed actions, and reasonably foreseeable future actions overlap in space and time, then the cumulative effects for alternative 2 are considered to be positive because present/ongoing actions also utilize design criteria similar to those for alternative 2’s silvicultural activities.

The estimated cumulative effects of alternative 2 are considered to be more positive than the estimated cumulative effects of alternative 3 because alternative 2 causes more beneficial change in HRV for composition, structure, and density than results from alternative 3 (see table 54 later in this report).

Alternative 3 – Wildlife-Related Modifications to Proposed Action

Direct effects are assumed to occur only on the portion of the forest vegetation affected environment included in alternative 3 (comprising app. 11,540 acres; see table 6).

Three indicators are used to present pretreatment and post-treatment trends for vegetation conditions: forest cover types, forest structural stages, and stand density classes. Direct effects on cover types, structural stages, and density classes are a consequence of implementing the five activities described earlier in this report: upland-forest commercial thinning, upland-forest noncommercial thinning, reforestation, juniper thinning and shrub-steppe enhancement, and aspen restoration (table 1).

Indirect effects consider the impact of direct effects on the larger forest vegetation affected environment in which they occur – the direct effects of implementing alternative 2 (app. 11,540 acres) are applied to the affected environment (app. 31,120 acres) to estimate indirect effects. The same three indicators are used to examine pre-treatment and post-treatment trends for analysis of indirect effects: species composition (forest cover types), forest structural stages, and stand density classes.

Species Composition (Forest Cover Types)

Species composition, as represented by forest cover types, is expected to change in response to implementation of silvicultural activities proposed for alternative 3 (see the post-implementation column in table 38). Most of the forest cover types affected by implementation of alternative 3 are late-seral (grand fir and Douglas-fir on upland-forest sites; western juniper on shrub-steppe environments), and they are reduced as a direct effect of implementation; the primary early-seral cover type (ponderosa pine) is increased as a consequence of implementing this alternative.

The post-implementation changes in forest cover types (2015) are viewed as beneficial because they directly support the Kahler project's purpose and need (e.g., "restore and promote open stands of old forest dominated by ponderosa pine, thereby moving the area toward its historical range in structure, density, and species composition"). Composition changes associated with alternative 3, however, are not as effective at addressing the purpose and need as composition changes associated with alternative 2.

By 2065, the near-term implementation effects of alternative 3 are not fully maintained – Douglas-fir and grand fir are still reduced in comparison to their pre-implementation situation (2012), but they have rebounded from their post-implementation (2015) situation. The same situation occurs for ponderosa pine – its 2065 level exceeds the 2012 amount, but is less than the 2015 acreage. Most other forest cover types are stable, exhibiting neither increases nor decreases.

Table 38: Direct effects for species composition for alternative 3

	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
Forest Cover Type	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Douglas-fir	3,660	32	520	5	1,940	17
Engelmann spruce	40	< 1	40	< 1	40	< 1
Grand fir	630	5	150	1	330	3
Nonforest	130	1	130	1	130	1
Ponderosa pine	6,840	59	10,670	93	9,070	79

Forest Cover Type	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
	Acres	Percent	Acres	Percent	Acres	Percent
Quaking aspen	10	< 1	10	< 1	10	< 1
Western juniper	210	2	0	0	0	0
Western larch	10	< 1	10	< 1	10	< 1
Total	11,530	99	11,530	100	11,530	100

Notes: Summarized from the Kahler vegetation database, but only for the portion of the affected environment to be modified by alternative 2 – approximately 11,540 acres.

Table 39 shows that the direct effects of implementing alternative 3 has an obvious, near-term influence on species composition when the effects are expressed for the entire forest vegetation affected environment (AE). As a result of implementing alternative 3, the representation of three forest cover types is reduced from pre-treatment levels (Douglas-fir, grand fir, and western juniper). The representation of ponderosa pine increases substantially for the AE – it transitions from 55% of the AE (pre-treatment) to 69% of the AE (post-treatment).

By 2065, the near-term beneficial implementation effects of alternative 3 on the forest vegetation AE are not maintained. Douglas-fir and grand fir both rebound to an extent where their 2065 acreage exceeds what it was in 2012. Ponderosa pine, lodgepole pine, quaking aspen, and western larch are also reduced to levels below their 2012 baseline acreage.

The 2065 outcome is related to two factors: (1) natural succession continues to cause substantial vegetation change on the portion of the AE not affected by implementation of alternative 3, and (2) acres treated by alternative 3 cannot be sustained in their post-treatment (2015) condition without follow-up maintenance treatments (thinning and prescribed fire) during the 50-year period (Ritchie et al. 2007).

Note that future maintenance treatments are not explicitly assumed for this analysis as they might be considered speculative; thinning and prescribed fire may occur during this 50-year timeframe (Marshall 2014), and they would be largely successful at preventing a return to pre-implementation conditions (Ritchie et al. 2007).

Table 39: Indirect effects for species composition for alternative 3

Forest Cover Type	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
	Acres	Percent	Acres	Percent	Acres	Percent
Douglas-fir	7,760	25	4,620	14	10,240	33
Engelmann spruce	60	< 1	60	< 1	60	< 1
Grand fir	1,440	5	960	3	2,080	7
Lodgepole pine	10	< 1	10	< 1	0	0
Nonforest	3,840	12	3,840	12	3,840	12
Ponderosa pine	17,220	55	21,040	69	14,360	46
Quaking aspen	20	< 1	20	< 1	10	< 1
Western juniper	740	2	530	2	530	2
Western larch	30	< 1	30	< 1	10	< 1
Total	31,120	100	31,110	100	31,130	100

Notes: Summarized from the Kahler vegetation database for the affected environment (approximately 31,120 acres; see table 6), and reflecting the direct effects of implementing alternative 3 on approximately 11,540 acres of the Kahler affected environment.

This forest vegetation analysis is informed by an analytical technique referred to as the Historical Range of Variation (HRV) (see Historical Range of Variation Analytical Technique section on page 17). HRV is used to examine the consequences of implementing the proposed action on species composition.

Table 40 presents results of an HRV analysis for species composition as it exists in 2015 (post-implementation) and 2065 (reflecting 50 years of vegetation development without any future retreatment of the 2012 acreage, other than periodic underburning); it suggests that alternative 3 was extremely effective at addressing the Kahler purpose and need with respect to species composition – immediately after treatment (2015), all of the forest cover types were within their ranges of variation except for western larch, which was slightly below the lower limit of its range.

By 2065, Table 40 shows that dry-forest cover types are still mostly within their ranges of variation with the exception of Douglas-fir, which is substantially above the upper limit of its historical range.

Table 40: HRV analysis of forest cover types for forest vegetation affected environment (alternative 3)

	DRY UPLAND FOREST POTENTIAL VEGETATION GROUP					
	Historical Range		Post-Treatment (2015)		Post-Treatment (2065)	
Forest Cover Type	Percent	Acres	Percent	Acres	Percent	Acres
Douglas-fir	5-20	1,350-5,400	17	4,570	38	10,180
Grand fir	1-10	270-2,700	3	850	7	1,930
Lodgepole pine	0	0	0	0	0	0
Ponderosa pine	50-80	13,500-21,600	78	21,030	53	14,350
Subalpine fir and spruce	0	0	0	0	0	0
Western juniper	0-5	0-1,350	2	530	2	530
Western larch	1-10	270-2,700	0	0	0	0
Western white pine	0-5	0-1,350	0	0	0	0
Whitebark pine	0	0	0	0	0	0
Total			100	26,980	100	26,990

Notes: Existing amounts are taken from the Kahler vegetation database. Gray shading indicates cover types that are above or below the historical range of variation. Historical ranges are taken from Martin (2010). Lodgepole pine, subalpine fir and spruce, and whitebark pine have zeroes for historical ranges because they would not be expected to occur on the dry upland forest biophysical environment. This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2). This analysis does not include quaking aspen because no historical range was provided for it in Martin (2010). It also does not include Dry UF acreage located outside of the affected environment but within the Kahler planning area, or Moist UF PVG or nonforest acreage.

Forest Structure (Forest Structural Stages)

Forest structure, characterized by using forest structural stages, is expected to change in response to implementation of silvicultural activities proposed for alternative 3 (see post-implementation column in table 41).

The 2015 (post-implementation) information in table 41 shows two primary changes resulting from implementation of alternative 3:

1) Old forest multi-strata (OFMS) stands received understory thinning treatments to transform them immediately to the old forest single stratum (OFSS) stage (400 acres of treatment).

2) Understory reinitiation (UR) stands were thinned to remove ladder fuels and increase residual tree growth and vigor – this change transitioned UR stands to the stem exclusion (SE) stage.

The post-implementation changes in forest structure (2015) are viewed as beneficial because they directly support the Kahler project's purpose and need (e.g., "restore and promote open stands of old forest dominated by ponderosa pine, thereby moving the area toward its historical range in structure, density, and species composition").

Why was a transition from UR to SE an objective of the silvicultural activities proposed for alternative 3? The answer relates to application of prescribed fire, and its role in maintaining the OFSS structural stage.

Prescribed fire (underburning) emulates a keystone disturbance process of dry-forest sites – occurrence of low-severity, high-frequency surface fire on a cycle of 5-20 years. By thinning UR stands, the lower cohort (layer) of trees is removed, and this lower cohort functions as ladder fuel. Without removing ladder fuel first, it is difficult or impossible to safely implement prescribed fire on these sites. After the ladder fuels have been removed, the proper structural stage assignment for these stands is SE.

The SE structure in this scenario functions as an intermediate stage on a successional trajectory culminating in stable and persistent OFSS (if it is maintained with frequent underburning). Overstory trees in an SE stand are too small to be considered for old forest, but they are large enough to be fire resistant. After thinning transforms UR to open SE, then prescribed fire can safely be applied (every 10-20 years) to reduce surface fuels, cycle nutrients, and manage future ingrowth of late-seral species, particularly Douglas-fir and grand fir for dry forests of Kahler planning area. In other words, thinning creates a post-implementation structural configuration (OFSS or SE) compatible with the purpose and need, but prescribed fire is crucial for maintaining these structures through time (Ritchie et al. 2007).

The ultimate result of this treatment regimen, and its resulting structural progression, is illustrated well in table 41 – by 2065, 87% of the Kahler proposed action acreage supports the OFSS structural stage, and the SE stage has all but disappeared by then (because most of it transitioned to OFSS).

Table 41: Direct effects for forest structure for alternative 3

Forest Structural Stage	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
	Acres	Percent	Acres	Percent	Acres	Percent
SI: Stand Initiation	150	1	150	1	0	0
SE: Stem Exclusion	4,280	37	7,050	61	150	1
UR: Understory Reinitiation	4,670	40	1,900	16	0	0
OFSS: Old Forest Single Stratum	970	8	1,370	12	10,000	87
OFMS: Old Forest Multi-Strata	1,340	12	940	8	1,250	11
Nonforest	130	1	130	1	130	1
Total	11,540	99	11,540	99	11,530	100

Notes: Summarized from the Kahler vegetation database, but only for the portion of the affected environment to be modified by alternative 2 – approximately 11,540 acres.

Table 42 shows that direct effects of implementing alternative 3 influenced the Kahler affected environment (AE) in 2015 in a similar way as for the Kahler proposed action acreage – the old forest structural stages (OFMS and OFSS) changed by equivalent amounts, the UR stage declines, and the SE stage increases.

Table 42: Indirect effects for forest structure for alternative 3

Forest Structural Stage	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
	Acres	Percent	Acres	Percent	Acres	Percent
SI: Stand Initiation	5,140	17	5,130	16	3,360	11
SE: Stem Exclusion	9,330	30	12,660	41	3,700	12
UR: Understory Reinitiation	8,690	28	5,360	17	5,490	18
OFSS: Old Forest Single Stratum	1,550	5	1,950	6	10,000	32
OFMS: Old Forest Multi-Strata	2,580	8	2,180	7	4,730	15
Nonforest	3,840	12	3,840	12	3,840	12
Total	31,130	100	31,120	99	31,120	100

Notes: Summarized from the Kahler vegetation database for the affected environment (approximately 31,120 acres; see table 6), and reflecting the direct effects of implementing alternative 2 on approximately 11,540 acres of the Kahler affected environment.

By 2065, near-term beneficial effects of alternative 3 (reflecting the 2015 information in table 42) on the forest vegetation AE are maintained or actually improved:
(1) Both of the old forest stages increase.
(2) Stem exclusion declines to a moderate proportion of the AE acreage.
(3) Stand initiation (SI) declines, reflecting slow but ongoing recovery of the Wheeler Point fire area.
(4) Understory reinitiation is maintained at moderate levels.

These findings reflect the overall structural stage situation for the Kahler AE – HRV results (table 43) demonstrate whether the 2015 and 2065 structural stage conditions are ecologically appropriate.

This forest vegetation analysis is informed by an analytical technique referred to as the Historical Range of Variation (HRV) (see Historical Range of Variation Analytical Technique section on page 17). HRV is used to examine the consequences of implementing the proposed action on forest structure.

Table 43 presents results of an HRV analysis for forest structure as it exists in 2015 (post-implementation) and 2065 (reflecting 50 years of vegetation development without any future retreatment of the 2012 acreage, other than periodic underburning); it suggests that alternative 3 is only moderately effective at addressing the Kahler purpose and need for forest structure – immediately after treatment (2015), the OFSS structural stage is under-represented, whereas the SE and UR stages are both over-represented. But as described above, this result is expected because the predicted increase in SE is only a stepping stone between UR (which is substantially over-represented as a Kahler existing condition – see table 12) and OFSS (which is dramatically under-represented for Kahler – see table 12).

By 2065, Table 43 suggests that the structural stage distribution is worse than it was in 2015 (because more of the 2065 boxes have gray shading than is true for the 2015 boxes). This conclusion is somewhat misleading, however, because the 2065 results show that the OFMS stage is slightly above HRV (by 2%) and the OFSS stage is slightly below HRV (by 3%).

Stand Density (Density Classes)

Stand density, as represented by using stand density classes, is expected to change in response to implementation of silvicultural activities proposed for alternative 3 (see the post-implementation column in table 44). Inspection of table 44 quickly shows that the alternative 3 silvicultural activities are expected to transform all of the moderate and high density class to the low density class.

Table 43: HRV analysis of forest structural stages for forest vegetation affected environment (alternative 3)

	DRY UPLAND FOREST POTENTIAL VEGETATION GROUP					
	Historical Range		Post-Treatment (2015)		Post-Treatment (2065)	
Forest Structural Stage	Percent	Acres	Percent	Acres	Percent	Acres
SI: Stand Initiation	15-25	4,050-6,750	19	5,130	12	3,360
SE: Stem Exclusion	10-20	2,700-5,400	47	12,660	14	3,700
UR: Understory Reinitiation	5-10	1,350-2,700	20	5,280	20	5,350
OFSS: Old Forest Single Stratum	40-60	10,800-16,200	7	1,950	37	9,970
OFMS: Old Forest Multi-Strata	5-15	1,350-4,050	7	1,960	17	4,600
Total			100	26,980	100	26,980

Notes: Existing amounts are taken from the Kahler vegetation database. Gray shading indicates cover types that are above or below the historical range of variation. Historical ranges are taken from Martin (2010). Lodgepole pine, subalpine fir and spruce, and whitebark pine have zeroes for historical ranges because they would not be expected to occur on the dry upland forest biophysical environment. This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2). This analysis does not include Dry UF acreage located outside of the affected environment but within the Kahler planning area, or Moist UF PVG or nonforest acreage.

The post-implementation changes in stand density (2015) are viewed as beneficial because they directly support the Kahler project's purpose and need (e.g., "restore and promote open stands of old forest dominated by ponderosa pine, thereby moving the area toward its historical range in structure, density, and species composition"). They would also contribute to rejuvenation of fire-suppressed shrub communities.

By 2065, near-term (2015) implementation effects of alternative 3 are not maintained – without follow-up thinning treatments during the intervening 50 years, most of the low density class is expected to transition to the moderate density class.

Note that follow-up thinning treatments were not assumed for this analysis as they might be considered speculative; prescribed fire may occur during this 50-year timeframe (Marshall 2014), however, and it will be partially effective at preventing a wholesale transition from low density to moderate density.

Table 44: Direct effects for stand density for alternative 3

	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
Stand Density Class	Acres	Percent	Acres	Percent	Acres	Percent
Low	1,650	14	11,410	99	270	2
Moderate	2,120	18	0	0	11,140	97
High	7,640	66	0	0	0	0
Nonforest	130	1	130	1	130	1
Total	11,540	99	11,540	100	11,540	100

Notes: Summarized from the Kahler vegetation database, but only for the portion of the affected environment to be modified by alternative 3 – approximately 11,540 acres.

Table 45 shows that direct effects of implementing alternative 3 have a similar influence on the affected environment (AE) in 2015 as they did on the proposed action acreage – the low density class almost doubled, while the moderate and high density classes decline dramatically.

By 2065, near-term beneficial effects of alternative 3 (reflecting the 2015 information in table 45) on the Kahler AE are not maintained – low density declines to a point where it is substantially less than either the moderate or high density classes (and the amount of low density in 2065 is substantially less than the 2012 baseline condition).

Table 45: Indirect effects for stand density for alternative 3

Stand Density Class	Pre-Implementation (2012)		Post-Implementation (2015)		Post-Implementation (2065)	
	Acres	Percent	Acres	Percent	Acres	Percent
Low	10,190	33	19,950	64	4,220	14
Moderate	4,540	15	2,430	8	12,320	40
High	12,550	40	4,900	16	10,750	35
Nonforest	3,840	12	3,840	12	3,840	12
Total	31,120	100	31,120	100	31,130	101

Notes: Summarized from the Kahler vegetation database for the affected environment (approximately 31,120 acres; see table 6), and reflecting the direct effects of implementing alternative 3 on approximately 11,540 acres of the Kahler affected environment.

This forest vegetation analysis is informed by an analytical technique referred to as the Historical Range of Variation (HRV) (see Historical Range of Variation Analytical Technique section on page 17). HRV is used to examine the consequences of implementing the proposed action on stand density.

Table 46 presents results of an HRV analysis for stand density as it exists in 2015 (post-implementation) and 2065 (reflecting 50 years of vegetation development without any future retreatment of the 2012 acreage, other than periodic underburning); it suggests that alternative 3 is only moderately effective at addressing the Kahler purpose and need for stand density – immediately after treatment (2015), low density, predominant historically as evidenced by the historical ranges shown in table 46, is well within its range of variation (and this is certainly a positive outcome of implementing alternative 3), whereas the moderate and high density classes are both outside of their historical ranges (but high is above its range by just 3%).

By 2065, table 46 suggests that follow-up treatments are needed if an objective is to maintain forest vegetation within its historical range of variation for stand density – all three of the density classes are outside of their historical ranges.

Follow-up thinning treatments were not assumed for this analysis as they might be considered speculative; prescribed fire may occur during this 50-year timeframe (Marshall 2014), and it will be partially effective at preventing a progression from low density back to moderate or high density conditions.

Table 46: HRV analysis of stand density classes for forest vegetation affected environment (alternative 3)

Stand Density Class	DRY UPLAND FOREST POTENTIAL VEGETATION GROUP					
	Historical Range		Post-Treatment (2015)		Post-Treatment (2065)	
	Percent	Acres	Percent	Acres	Percent	Acres
Low	40-85	10,790-22,930	73	19,820	16	4,220
Moderate	15-30	4,050-8,090	9	2,410	45	12,190
High	5-15	1,350-4,050	18	4,750	39	10,570
Total			100	26,980	100	26,980

Notes: Existing amounts are taken from the Kahler vegetation database. Gray shading indicates cover types that are above or below the historical range of variation. Historical ranges are taken from Martin (2010). This analysis includes unsuitable NFS lands included in the Kahler proposed action (see table 6, footnote 2); it does not include Dry UF acres located outside the AE but within the Kahler planning area, or Moist UF PVG or nonforest acreage.

Project Design Features and Mitigation Measures

Project design features pertaining to silvicultural activities and upland-forest treatments are provided in a separate Kahler environmental assessment document containing design elements for all resource areas. The silviculture design features are contained in a section called ‘Vegetation’.

Cumulative Effects

Past actions, including timber harvest (fig. 8), tree planting, and noncommercial thinning, helped create existing conditions in the planning area. Silvicultural activities associated with alternative 3 are designed to address the project’s purpose and need by helping to move species composition, forest structure, and stand density back within their historical ranges of variability. Moving these ecosystem components back within their historical ranges is expected to improve forest health, vegetation vigor, and ecosystem resilience to fire, insects, and disease.

Present (ongoing) actions include noncommercial thinning and prescribed fire activities authorized by categorical exclusions (CE) in 2009; some of the CE-authorized noncommercial thinning occurred in the Kahler planning area from 2010 to 2012 (fig. 15). Noncommercial thinning specifications for the District-wide noncommercial thinning CE were designed to address similar issues and concerns as those influencing the Kahler Dry Forest Restoration project. Therefore, they represent incremental actions (beyond the proposed silvicultural activities) that are also responsive to the Kahler project’s purpose and need.

No reasonably foreseeable future actions are anticipated for the Kahler planning area over the next five years, as based on a review of the Umatilla National Forest’s schedule of proposed actions (SOPA).

When considering direct and indirect effects of alternative 3’s silvicultural activities on species composition, forest structure, and stand density, and when evaluating how direct and indirect effects of past actions, present (ongoing) actions, proposed actions, and reasonably foreseeable future actions overlap in space and time, then cumulative effects for alternative 3 are considered to be positive because present/ongoing actions also utilize design criteria similar to those for alternative 3’s silvicultural activities.

The estimated cumulative effects for alternative 3 are considered to be positive, but less so than the estimated cumulative effects associated with alternative 2 because alternative 3 causes slightly less beneficial change in HRV for composition, structure, and density than results from implementation of alternative 2 (see table 54 later in this report).

Regulatory Framework

Land and Resource Management Plan

The Umatilla National Forest Land and Resource Management Plan (LRMP) provides standards and guidelines for forest vegetation. Management direction pertaining to forest vegetation, including desired conditions for individual Forest Plan management areas occurring in the Kahler planning area, are provided in a Management Direction section presented earlier in this report.

Consistency of Proposed Silvicultural Activities with NFMA

The National Forest Management Act (NFMA; Public Law 94-588; 16 U.S.C. 1600) requires specific findings to be made and documented when considering the implementation of certain management practices. The following is documentation of specific NFMA compliance findings for proposed silvicultural activities in the Kahler planning area. Based on analyses described in this report, and on proposed silvicultural prescriptions for the Kahler project, the following findings pursuant to NFMA are made.

Consistency

Finding: As described in the Management Direction section of this report, silvicultural activities proposed for implementation during the Kahler project are fully consistent with the Umatilla National Forest Land and Resource Management Plan (Forest Plan), as amended, and all of its relevant Forest Plan components (standards, guidelines, objectives, desired future conditions, etc.).

Finding: Selection of a silvicultural system (even-aged or uneven-aged cutting methods, including intermediate and regeneration activities) is guided by eight criteria provided in a "Silvicultural Systems Selection" section of the Forest Plan (USDA Forest Service 1990, pages 4-67 and 4-68).

Suitability

Finding: As described in the Management Direction section of this report, all silvicultural activities will be implemented only on lands meeting the definition of forest land (16 U.S.C. 1604) and designated as suitable for timber production by the Forest Plan (USDA Forest Service 1990), as amended, except for:
(1) App. 30 acres of unsuitable land for which a site-specific FP amendment will authorize commercial timber harvest to address specific needs related to the Tamarack fire lookout administrative site.
(2) App. 680 acres (alternative 2) or 660 acres (alternative 3) of PACFISH class IV riparian habitat conservation areas where silvicultural activities will be implemented to help achieve riparian management objectives, as allowed by the PACFISH amendment to the Forest Plan – RHCAs are designated as unsuitable for timber production by the PACFISH amendment, but timber harvest is permissible if it contributes to attainment of riparian management objectives.
(3) App. 130 acres (alternatives 2 and 3) of the 'juniper thinning and shrub-steppe enhancement' silvicultural activity are associated with nonforest (shrub/herb) or woodland biophysical environments. Not all of this treatment would occur on lands classified as forest land, or on lands designated as suitable for timber production. This proposed treatment addresses juniper encroachment onto areas that historically supported important wildlife habitats consisting primarily of shrubland (e.g., bitterbrush, mountain-mahogany, etc.) and grassland species.

Appropriateness of Even-aged Management

Finding: This NFMA requirement is not applicable to the Kahler Dry Forest Restoration Project because all of the proposed silvicultural activities, regardless of whether their implementation will result in commercial timber harvest, are intermediate treatments such as commercial thinning – no even-aged regeneration cutting is proposed for the Kahler project.

Optimality of Clearcutting

Finding: This NFMA requirement is not applicable to the Kahler Dry Forest Restoration Project because the proposed silvicultural activities, regardless of whether their implementation will result in commercial timber harvest, are intermediate treatments such as commercial thinning. In other words, no clearcutting is proposed for the Kahler project. Small openings called gaps, generally ranging in size from ½ to 2 acres, will be created during implementation of an intermediate cutting method called 'variable-density thinning with skips and gaps' (VDT) (see pages 3-6). Gaps and VDT are examples of the ecological forestry concepts being used for the Kahler project (Franklin and Johnson 2012; Franklin et al. 2007, 2013; Larson and Churchill 2012). Gaps are too small to qualify as clearcuts according to Forest Service policy.

Vegetation Manipulation

Finding: Tree stand manipulation complies with requirements found in 16 U.S.C. 1604, as follows:

1. The proposed silvicultural activities are well suited to the multiple-use goals and objectives established for the Kahler planning area when considering the potential environmental impacts associated with their implementation.
2. There is ample assurance that lands proposed for regeneration cutting (created openings in the context of the Forest Plan) will be adequately restocked within five years after final harvest.
   [Note: this requirement is not applicable to the Kahler Dry Forest Restoration Project because none of the proposed silvicultural treatments will result in created openings, although gaps created as part of the variable-density or ICO commercial thinning treatments may be planted with early-seral tree species when doing so helps assure that Forest Plan minimum stocking levels will be attained within 5 years of harvest.]
3. The proposed silvicultural prescriptions are not chosen primarily because they will give the greatest dollar return or the greatest output of timber, although these factors were considered when evaluating whether a proposed silvicultural activity is economically viable.
4. The potential implementation effects on residual trees and adjacent stands are considered when developing silvicultural proposals.
5. No permanent (e.g., irreversible) impairment of site productivity is expected as a result of the proposed silvicultural activities, and the project's design features, management requirements, and best management practices ensure conservation of soil, slope, and other watershed conditions.
6. As described in the Management Direction section of this report, Riparian Habitat Conservation Areas (RHCAs) will be specifically designated on the ground in such a way as to exclude their full extent from any adjacent upland forest area selected for silvicultural treatment. In some instances, however, portions of class IV dry-forest RHCAs are proposed for silvicultural treatment. The provision of no-mechanical-treatment zones within class IV RHCAs proposed for treatment is deemed to be a sufficient and appropriate measure for protecting streams, streambanks, shorelines, lakes, wetlands, and other bodies of water from potentially adverse project effects on water conditions or fish habitat (16 U.S.C. 1604(E)(iii)).
7. Silvicultural activities proposed for implementation in the Kahler Dry Forest Restoration Project are expected to provide desired effects with respect to water quantity and quality, wildlife and fish habitat, regeneration of desirable tree species, forage production, recreation uses, aesthetic values, and other resource yields.
8. Silvicultural activities proposed for implementation in the Kahler Dry Forest Restoration Project are considered practical in terms of transportation and harvesting requirements, and total financial costs of project preparation, timber harvest, and sale administration.

Other Guidance or Recommendations

Consideration of Best Available Science

The analysis information provided in this report is based on a variety of methodologies, models, and procedures, all of which are derived from scientific sources included in the References Cited section. Many of the analytical processes are based on local protocols described in white papers, and documentation for them is also included in the References Cited section.

Forest Service policy is that projects must be consistent with the Forest Plan and show consideration of 'best available science' (Dillard 2007). Science is not absolute or irrefutable – much of what we know in a science context is constantly evolving (Moghissi et al. 2008). This means that what constitutes best available science might vary over time and across disciplines (Dillard 2007). An objective of considering best available science is for scientists "to provide a meaningful context to scientific information so that its validity might be judged and therefore useful to the policymaker" (Moghissi et al. 2008).

In the context of Best Available Science, local protocols and similar information issued by government agencies is considered to be gray literature if not subjected to an independent peer review (Moghissi et al. 2008). Note that several of the local protocols (Powell 2013a, 2014b, 2014c; Schmitt and Powell 2014) were not independently peer reviewed and therefore qualify as gray literature; four of the protocols (Powell 1999, 2010, 2014a; Powell et al. 2007) were peer reviewed and therefore constitute 'peer-reviewed science' (Moghissi et al. 2008).

With few exceptions (textbooks, primarily), sources contained in the References Cited section of this specialist report are available from the World Wide Web in digital form, and a Digital Object Identifier (doi) is included for these items whenever possible. [Digital object identifier is an international system used to uniquely identify, and link to, electronic journal articles.] All doi links pertain to formally published sources only; local analysis protocols, monitoring reports, and similar items will not have a doi.

Note that a doi is provided for as many of the literature citations as possible to facilitate access to the item. Some of the doi links will allow free downloading of the electronic content in PDF format; other doi links will access a publisher's website (providing an abstract and other information about the work), but payment will be required to download the full work in PDF format. Note that for books in the literature cited section, an International Standard Book Number (ISBN) is provided at the end of the citation. An ISBN number allows ready access to information about the book from Amazon.com or another bookseller, or the ISBN number can be entered in a web search engine (Google, etc.) to access the publisher's website for further information about the work.

Two white papers are incorporated by reference for this forest vegetation specialist report. The dry-forest white paper (Powell 2014a) contains more than 1,000 references; the HRV white paper (Powell 2014b) contains more than 200 references. These references from the two white papers, totaling more than 1,200, are also incorporated by reference into the References Cited section of this specialist report.

Although many more sources were considered than what is included in the References Cited section of this specialist report, I believe the References Cited section clearly demonstrates that Best Available Science was considered when completing forest vegetation analyses documented in this specialist report.

Danger Trees Along Roadways

Danger trees or hazard trees are defined as "a standing tree that presents a hazard to people due to conditions such as, but not limited to, deterioration or physical damage to the root system, trunk, stem, or limbs and the direction or lean of the tree" (USDA Forest Service 2007). The objective of removing danger trees is to improve public safety for visitors to the Kahler planning area by reducing danger-tree hazards in areas where people travel and recreate.

A danger tree is any tree hazardous to people or facilities because of the following factors or conditions (Toupin et al. 2008, USDA Forest Service 2007):

1. Its location.
2. Its degree and direction of lean.
3. Presence and type of physical damage.
4. Deterioration of limbs, stem, or root system from disease, decay, and other biotic factors.
5. Presence of overhead hazards from dead tops, hung-up trees, or unattached branches.
6. Any combination of the above.

Danger trees are identified and evaluated using a standard protocol (Toupin et al. 2008). Danger tree evaluations are completed by qualified personnel who have completed specific training for this activity. The Forest Service has established policy and direction for how danger trees will be identified, evaluated, and managed along the transportation system (USDA Forest Service 2007). Three types of danger trees are identified by the evaluation protocol:

1. Trees with a low failure probability (within 10 years of rating).
2. Trees with a likely failure probability (within 3-5 years of rating).
3. Trees with an imminent failure probability (within 1 year of rating).

For the Kahler Dry Forest Restoration Project, danger trees will be identified, evaluated, and removed (or addressed by using other remediation actions such as felling and leaving in place) from any portion of the transportation system used for timber sale activities, along access roads for developed recreation sites such as Fairview Campground, and for administrative sites such as Tamarack fire lookout. When possible and economically feasible, danger trees will be removed during the course of other timber harvest operations. A Kahler project design feature is specifically directed toward remediation of danger trees – it is design feature VG8 in the Vegetation section of the Kahler project design features table.

Climate Change Considerations

The Intergovernmental Panel on Climate Change (IPCC) (IPCC 2014), the most recent National Climate Assessment (Melillo et al. 2014), and other sources suggest that the magnitude and pace of climate change in forest ecosystems will be unprecedented. Climate change is capable of changing forests to meadows, and changes of this extent will trigger a cascade of associated impacts on plants, wildlife, and other ecosystem components.

For the Blue Mountains ecoregion containing the Kahler planning area, monthly average temperature during the 21st century is projected to increase by ~3.3°C in winter (December-February) and 5.0°C in summer (June-August). Projected changes in precipitation vary substantially among models, but the central tendency is for increased precipitation (~15%) in winter (November-February) and decreased precipitation (~17%) in summer (June-September) (Mauger and Mantua 2011).

Changes in temperature and precipitation are expected to have important implications on soil moisture, water availability, and streamflow timing for the Blue Mountains. Projections for the end of this century are for a 69-72% decrease in April 1st snowpack, with snowmelt occurring at least 3 week earlier than at present. Projected changes in soil moisture, which have important implications on tree growth and stand vigor (Grant et al. 2013), show increases in average winter amounts (12-13% for January-April) and decreases in average summer storage (4-7% for June to September) (Mauger and Mantua 2011).

When considering possible influences on climate change, including production of greenhouse gases, the overall scope of the Kahler proposed action is minor because approximately 12,220 acres of silvicultural activity (the Kahler Proposed Action) will affect:

1. 37% of the Kahler planning area (consisting of 32,840 acres)
2. 6% of the Heppner Ranger District (consisting of 209,930 acres)
3. 1% of the Umatilla National Forest (consisting of 1,406,510 acres)
4. 0.2% of the Blue Mountain national forests (Malheur, Umatilla, Wallowa-Whitman) (consisting of 5,135,750 acres).
   [When establishing a climate change context for the Kahler proposed action, all three of the Blue Mountains national forests are included because the Blue Mountains ecoregion (province) is considered to be the most appropriate scale at which to evaluate climate change impacts.]

In order to fulfill its mission, vision, and guiding principles, the Forest Service will need to respond to climate change promptly and effectively. Two responses are especially important – actions designed to increase near-term resistance to climate change (mitigation), and actions designed to improve long-term resilience to climate change (adaptation). As described in table 47, the Kahler Dry Forest Restoration Project includes both resistance and resilience actions.

Examination of projected climate change impacts suggest that a project of Kahler's scope will contribute such minimal amounts of greenhouse gas that its impact on global or national climate change will be infinitesimal. Therefore, direct and indirect contributions to greenhouse gas and climate change from implementation of either alternative 2 or 3 will be negligible.

In addition, because the direct and indirect effects will be negligible, projected contributions from either action alternative to cumulative effects on greenhouse gas and climate change will also be negligible.

The minor scope of the proposed action suggests it would be inappropriate to attempt to isolate climate change effects directly or indirectly attributable to implementation of the Kahler Dry Forest Restoration project. Our current understanding of climate science suggests it is difficult, if not impossible, to establish a cause-and-effect relationship between silvicultural activities and climate change **at a project scale**.

For the reasons described above, climate change is not used as an explicit issue during the NEPA process, and no indicators are established for comparing climate change effects between alternatives.

Certain principles and concepts of climate change, however, can be used to assess whether silvicultural activities included in the Kahler proposed action will be expected to maintain or enhance forest adaptation to the predicted effects of climate change. Many of these principles and concepts are described in the captions for figures 16-17 and 20, and in the adaptation strategies presented in table 47.

As described above, two general strategies are used to address climate change: mitigation and adaptation. Mitigation involves reducing greenhouse-gas emissions now in order to minimize the near-term pace and magnitude of climate change. Adaptation accepts that climate change will occur (and is occurring now), so it involves making ecosystems more resilient to the projected effects of future climate fluctuations.

Two of the silvicultural activities included in the Kahler proposed action are considered to be compatible with a mitigation strategy (Baron et al. 2008, Nabuurs et al. 2007, Reyer et al. 2009, Salinger et al. 2005) – intermediate cutting (both commercial and noncommercial thinning) and reforestation both contribute to a 'maintain forest area' mitigation objective (i.e., ensure that lands currently supporting forest continue to support forest in the future) (Nabuurs et al. 2007).

Table 47: Compatibility of silvicultural activities and climate change adaptation strategies

Climate Change Adaptation Strategies Relating to Forest Vegetation	Compatibility of Adaptation Strategy with Kahler Silvicultural Activities
Improve the capability of ecosystems to withstand uncharacteristically severe drought, wildfire (fig. 16), and insect outbreaks at landscape scales.	Implementing silvicultural activities will reduce insect and disease susceptibility and potential for uncharacteristic fire (fig. 9). Thinnings will be aggregated into larger blocks to emulate historical patterns of surface fire (Heyerdahl 1997).
Facilitate natural (evolutionary) adaptation through silvicultural treatments that shorten regeneration times and promote interspecific competition.	Action alternatives include variable-density thinning and reforestation, which can shorten regeneration times and promote interspecific competition. Reforestation emphasizes early-seral species, which are projected to be more compatible with future climate conditions (warmer, dryer) in the planning area.
Where ecosystems will very likely become more water limited, manage for drought- and heat-tolerant species.	Specifications for how the silvicultural activities will be implemented account for species-specific life history traits influencing drought and heat resistance. Drought-tolerant species are preferentially retained during thinnings, and they are also incorporated in the species mix to be used for reforestation.
Reduce homogeneity of stand structure and synchrony of disturbance patterns across broad landscapes by promoting diverse age classes and species mixes, stand diversities, and genetic diversity.	Rationale for proposing silvicultural activities is based primarily on HRV results, and several HRV components (composition and structure) effectively account for age-class, species, and successional-stage diversity. Reforestation promotes species and age-class diversity.
Reset ecological trajectories to take advantage of early successional stages that are adaptive to present rather than past climates.	Creation of open gaps during variable-density thinning will reset ecological trajectories for small portions of thinning units; reforestation will use a mixed species composition featuring early-seral (early-successional) tree species.
Use historical ecological information to identify environments buffered against climate change and which would be good candidates for conservation.	Historical forest structure would be resilient to projected climate change (fig. 17). This structure will be conserved when it currently exists, or restored quickly if large remnant trees are still present. Using variable-density thinning will reintroduce spatial heterogeneity and create resilient stand density levels.
Encourage local industries that can adapt to or cope with variable types of forest products because of the uncertainty about which tree species will prosper in the future.	It is anticipated that some portion of the timber harvest will be accomplished by using stewardship or similar alternatives. Local stewardship or biofuel/bioenergy industries are capable of dealing with unconventional species or product types.
Reforestation after disturbance may require different species than were present before the disturbance to better match site-level changes associated with climate change.	Reforestation will use a mixed species composition emphasizing drought-tolerant species. All of the reforestation species currently exist in the planning area; there is no proposal to introduce non-native trees such as Gambel oak or pinyon pine.
After a disturbance event, use intensive site preparation activities to remove competing vegetation and replant with high-quality, genetically appropriate and diverse stock.	Gaps created during variable-density thinning will be reforested after using conventional hand scalping to remove competing vegetation; seedlings to be out-planted are produced from genetically diverse, but local, seed sources.
To promote climate resilience for existing stands, use widely spaced thinnings or shelterwood cuttings and rapid response to forest mortality from fire or insects.	Thinning treatments will be designed to produce the widest reasonable residual-tree spacing; rapid response to forest mortality is not explicitly incorporated in the action alternatives for the Kahler Dry Forest Restoration Project.
Plan for higher-elevation insect outbreaks, species mortality events, and altered fire regimes.	Silvicultural activities anticipate accelerated future mortality of Douglas-fir and grand fir because they are less drought-tolerant than ponderosa pine, and both of them are less resistant to a high fire environment (fig. 16) than ponderosa pine.

Sources/Notes: Climate change adaptation strategies pertain to forest vegetation only and were derived from Joyce et al. (2008, 2009) and West et al. (2009). Predicted compatibility of each adaptation strategy with Kahler's silvicultural activities is provided by the author of this specialist report.

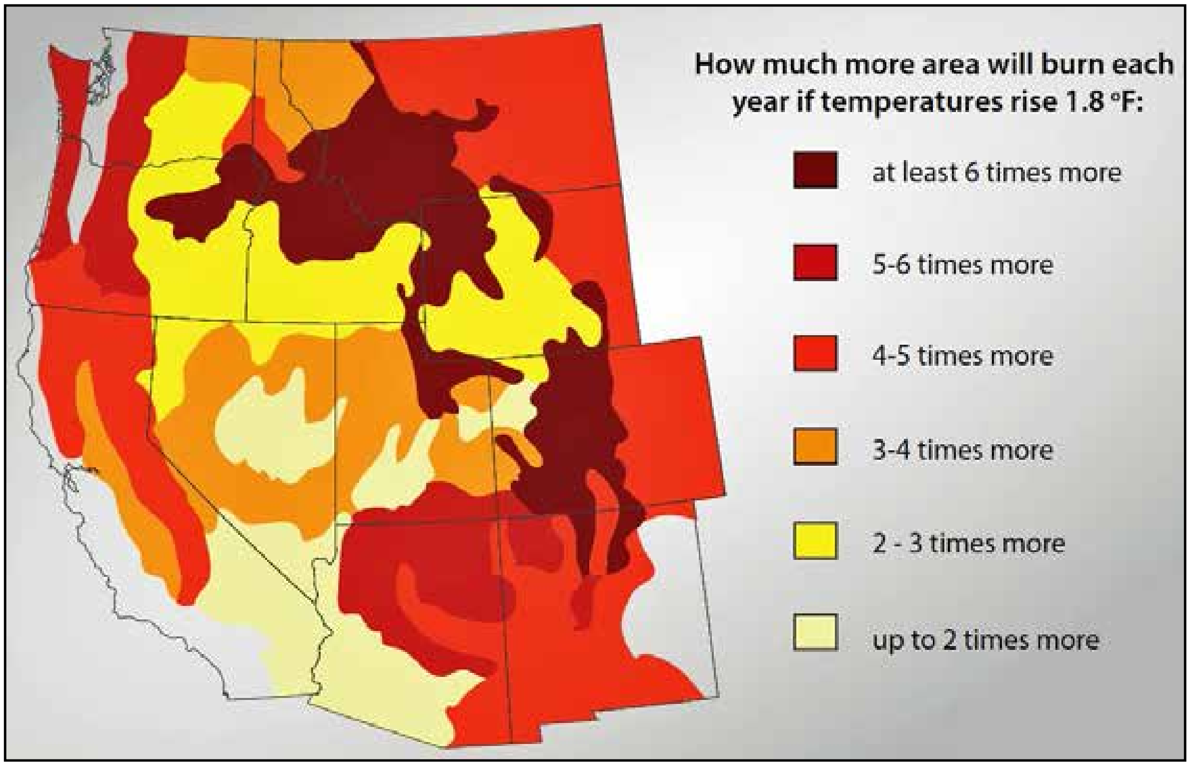


Figure 16 – Projected increase in wildfire area burned with a mean annual temperature increase of 1 °C (1.8 °F), shown as a percentage change relative to median annual area burned during 1950-2003 (source: Climate Central 2012, as adapted from fig. 5.8 in National Research Council 2011). Results are aggregated to eco-provinces (Bailey 1995) of the western United States; the Blue Mountains occur in a large brown zone with projected burn-area increases of at least six times. Climate-fire models were derived from National Climatic Data Center climate division records; observed burn-area data follows methods described in Littell et al. (2009). This map is alarming because when comparing the 1970-99 and 2070-99 time periods, an increase in average temperature of 3.3 to 9.7 °C is projected, and the increase will be greatest in summer during fire season. This figure, in combination with an HRV analysis of existing stand density conditions for the Kahler planning area (see table 14, which shows that existing amounts of the high stand density class are substantially above the upper limit of the historical range), suggests that future wildfire effects could continue to be uncharacteristic (figs. 9, 18) unless thinnings and other density-management treatments are implemented in the near future to reduce stand density levels. As noted in many other assessments, "the most extensive and serious problem related to health of national forests in the interior West is the overaccumulation of vegetation, which has caused an increasing number of large, intense, uncontrollable and catastrophically destructive wildfires" (GAO 1999). The Kahler project proposes to respond to high levels of existing stand density by implementing thinning treatments and prescribed fire to reduce stand density (fig. 19). In the climate change context shown here, "lower stand densities may be necessary in a warmer climate to achieve the same level of reduced intertree competition as was achieved in the past" (Peterson et al. 2011). We agree that lower stand densities will be needed as an adaptation measure to address future temperature increases, so thinning treatments proposed for the Kahler Dry Forest Restoration Project anticipate reducing existing stand densities all the way down to the lower limit of the management zone, as specified in Cochran et al. (1994) and Powell (1999). After thinning, prescribed fire will be implemented regularly as a maintenance activity to preclude establishment of additional tree regeneration ('ingrowth'), and thereby sustain stand densities at the lower levels most compatible with a warmer and dryer future.

While mitigation is crucial, adaptation to climate change is increasingly viewed as a necessary and complementary strategy to mitigation (Joyce et al. 2009, Peterson et al. 2011). Table 47 includes a list of adaptation strategies proposed for the National Forest System as a whole, and pertaining to forest vegetation (these are shown in the left column). Table 47 also describes how silvicultural activities included in the Kahler proposed action are compatible with proposed adaptation strategies (shown in right column).

Figure 17 – Historical dry-forest conditions near the Kahler planning area. This image shows a stand of ponderosa pine in the western portion of township 6 south, range 28 east near Bear Creek. It was taken by Henry Langille on Monday, June 22, 1903 at 10:30am and looking in a westerly direction (Langille 1903b). Langille's description for this photograph is: "Type of better quality yellow pine timber such as occurs in basins and other places where this is sufficient depth of soil." Note the presence of large, down wood and a paucity of herbaceous undergrowth vegetation, suggesting relatively heavy livestock grazing pressure (Langille's report estimated that 300,000 sheep and lambs were grazing on the Heppner Reserve in 1903!) (Langille 1903a). Pioneer journals (Evans 1991), early surveys (Gannett 1902, Langille 1903a, Munger 1917), and fire history studies (Heyerdahl 1997, Maruoka 1994) suggest that many dry-forest sites in the Blue Mountains had presettlement conditions similar to those depicted in this image. The Kahler Dry Forest Restoration Project purpose and need is to restore the composition, structure, and density shown here for the Dry Upland Forest biophysical environment (BE) within the Kahler planning area. This historical information provides valuable insights about environments that are projected to be effectively buffered against climate change.

IPCC concluded with high confidence (8 out of 10 chance) that "disturbances such as wildfire and insect outbreaks are increasing and are likely to intensify in a warmer future with drier soils and longer growing seasons, and to interact with changing land use and development affecting the future of wildland ecosystems" (Parry et al. 2007, page 56).

The IPCC conclusion demonstrates that climate change involves more than the direct effects of warming temperatures and variable precipitation – it includes indirect effects of climate change on wildfire, insect outbreaks, and other biotic and abiotic disturbance processes (fig. 16).

Table 47 suggests that thinning and prescribed fire activities addressing stand vulnerability to uncharacteristic levels of tree mortality caused by wildfire (Ritchie et al. 2007), along with other climate-related changes in disturbance regimes, could meet near-term mitigation and mid-term adaptation objectives if such practices also reflect goals for other ecosystem services such as late-old structure and water quality (Joyce et al. 2009).

Summary: Compatibility of Silvicultural Activities with Projected Climate Change

Three categories of silvicultural activities are included in the Kahler proposed action: intermediate cutting (commercial and noncommercial thinning methods), prescribed fire (underburning in treated stands), and reforestation (see table 1). Projected changes in future temperature and precipitation for a large region containing the Kahler planning area are expected to have varying interactions with silvicultural activities included in the Kahler proposed action.

1. **Thinning Activities (commercial and noncommercial thinning).** Climate modeling suggests that drought conditions will be more common in the future because mid-summer temperatures are expected to be substantially higher than at present. Dense tree stands exist in a sort of perpetual physiological drought because there is not enough soil moisture to meet the water needs of all trees; thinning is used to alleviate this moisture stress and allow the residual trees to survive and continue growing. It is expected that future climate conditions will have demonstrably more impact on dense stands than is produced by the current climate, so the need for thinning is expected to be much greater in the future than at present. Thinning also improves physiological vigor, and trees with improved vigor produce more of the resins used to repel insect and disease attacks (Kolb et al. 1998, Mitchell et al. 1983, Pitman et al. 1982, Safranyik et al. 1998). Thinning disrupts canopy fuel continuity, which helps address future crown-fire risk (Agee 1996, Powell 2010, Scott 1998). Insect outbreaks and wildfire are both predicted to occur at significantly higher levels in a warmer and dryer future than at present (Canadell and Raupach 2008, Kurz et al. 2008, Westerling et al. 2006, Williams and Liebhold 1995). In particular, thinning can help address future defoliator susceptibility by removing the late-seral tree species. "The extent of [tussock moth] habitat is growing as the density and extent of fir increases. The tussock moth outbreak on the Heppner Ranger District in 2000 caused defoliation on 5,000 acres that were historical ponderosa pine sites that had never previously reported tussock moth. These areas are similar to many areas in the Blue Mountains that now support dense, multistoried grand fir and Douglas-fir stands where historically open ponderosa pine, western larch, and some Douglas-fir thrived. We can expect continued, increased areas of tussock moth outbreaks and other defoliators such as western spruce budworm as the area and density of late seral habitat continues to grow in the absence of frequent, light, widespread surface fires" (Spiegel 2013).
2. **Reforestation.** This silvicultural activity will be used to help reestablish tree cover in the Wheeler Point fire of 1996 (figs. 2, 9, 18), and to influence species composition in gaps created by application of variable-density thinning with skips and gaps (VDT). When considering the life-history traits of tree species in the Kahler planning area, many of which have a direct bearing on reproductive capacity, the species to be emphasized during implementation of the reforestation activity are: ponderosa pine and western larch (primary emphasis), and Douglas-fir (secondary emphasis). These three species are the same ones identified below (item #3) as being most adaptable to future climate change. This means that species with optimal fitness for post-harvest environmental conditions are also predicted to have acceptable fitness for a warmer and dryer climate. Natural regeneration is expected for some portions of the Wheeler Point fire, and in areas receiving the VDT treatment, so ultimate species diversity for these areas will likely be greater than just the three species being planted.
3. **Prescribed Fire (underburning in treated stands).** This silvicultural activity is expected to function primarily as a maintenance treatment – after thinnings occur to reduce stand density, improve tree and stand vigor, and disrupt canopy continuity, prescribed fire will be used to reduce surface fuels (including activity fuels created by thinning treatments), cycle nutrients, and kill some proportion of newly established natural regeneration (including 'ingrowth' occurring after thinning treatments). It will be useful to consider the life-history traits of native trees and how they might influence the fitness of a species to survive not only more prescribed fire than we apply at present, but also more wildfire (fig. 16). The life-history traits of tree species in the Kahler planning area suggest that ponderosa pine and western larch will be particularly well-adapted to higher levels of prescribed and wild fire than occur at present. When considering predicted impact of climate change on temperature and precipitation,

and when considering the effects of climate change on wildfire (fig. 16), it is likely that ponderosa pine, western larch, and Douglas-fir will be best adapted to future climates of the planning area.

After completing the thinning treatments, and then after completing the first application of prescribed fire in treated areas to reduce activity fuels created by the thinnings and reinvigorate stagnant nutrient cycling resulting from a long period of fire exclusion, the treatment units will be considered to have attained Fire Regime Condition Class (FRCC) 1 (Schmidt et al. 2002). Prescribed fire (underburning) will be crucial for maintaining these areas in Condition Class 1 because recurring fire will prevent them from transitioning back to Condition Class 2 or 3 (Ritchie et al. 2007).

The dry-forest white paper (Powell 2014a), which was incorporated by reference, describes how forest vegetation conditions vary from the 'ecosystem maintenance stage' (fire regime condition class 1) to the 'ecosystem degradation stage' (fire regime condition class 3); in particular, see table 5 on page 55 in Powell (2014a) for descriptions and illustrations of the condition classes and their associated stages.

Underburning thousands of acres in the Kahler planning area will directly release carbon dioxide during the burning operation, which contributes to increasing concentrations of greenhouse gases. However, research indicates that restoration (and then maintenance) of an FRCC 1 condition will result in lower risk of uncharacteristically severe wildfire for the treated areas (Hurteau and North 2010) (fig. 20). The Wheeler Point fire, a portion of which is located within the Kahler planning area, provides a good example of uncharacteristic fire effects for dry-forest sites: see figs. 2, 9 and 18.

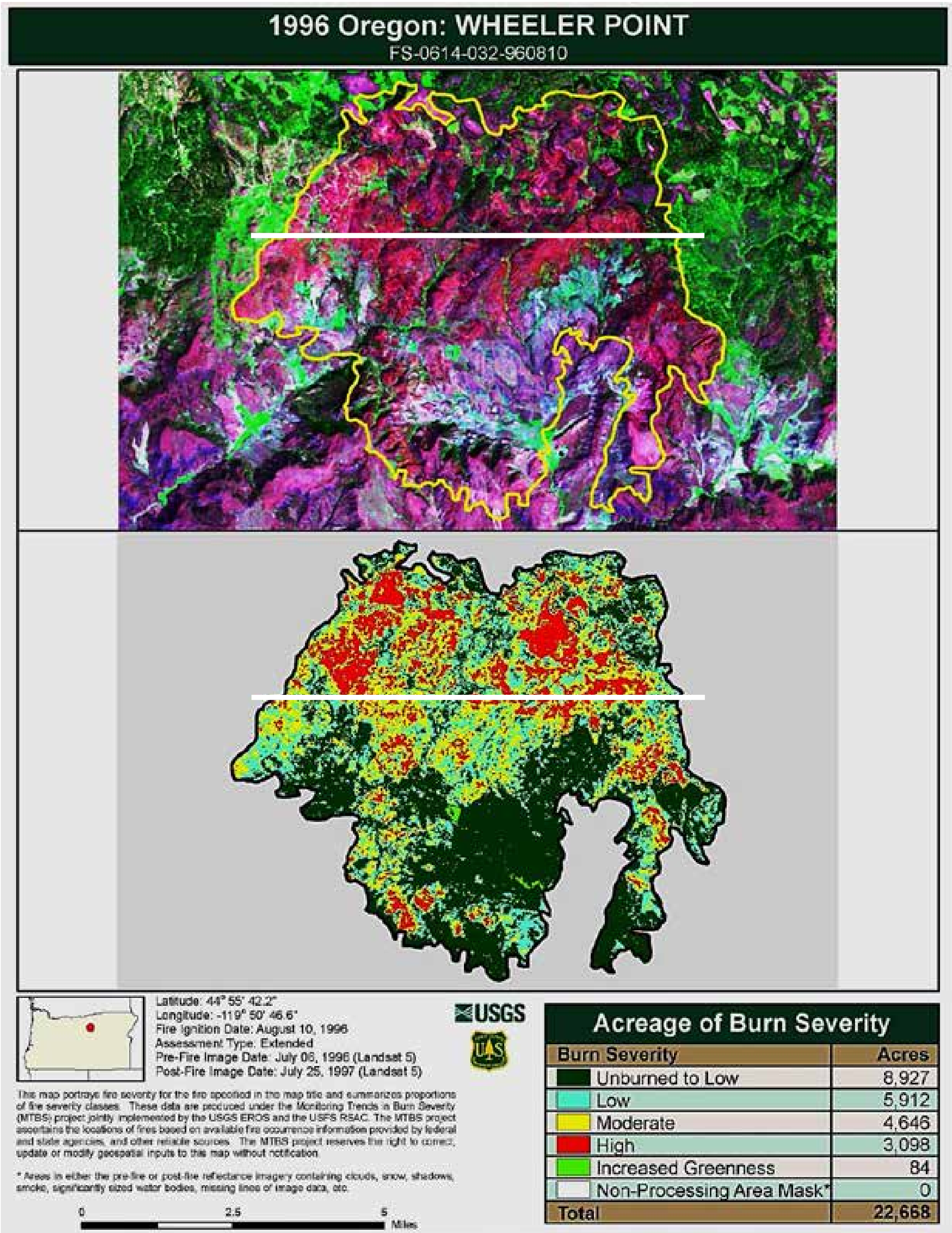
Reduced fire risk has a two-fold effect on greenhouse gas emissions and the carbon cycle:

a. Although greenhouse gases are released during a prescribed fire operation, the application of prescribed fire has a direct beneficial effect on future greenhouse gas emissions because the future risk of these areas burning with uncharacteristic wildfire severity (figs. 9 and 18), which emits much more greenhouse gas than is released by prescribed fire, has been reduced by using prescribed fire now (Wiedinmyer and Hurteau 2010).
b. There is an indirect beneficial effect of prescribed fire because live stands of trees will retain higher capacity to sequester carbon dioxide in comparison to stands killed by uncharacteristic wildfire (Dore et al. 2012) (fig. 20), particularly if dead tree stands are not promptly reforested.

Note: The Wheeler Point fire (figs. 2, 9, 18) has approximately 5,000 acres of non-stocked area where tree cover is so sparse that the land currently does not qualify as forest (because tree canopy cover is less than 10%, the national definition of forest land; Brohman and Bryant 2005). Many of these areas are now occupied by snowbrush ceanothus, other shrubs, and graminoids (grasses and sedges), and this 'competing vegetation' is likely to impede tree regeneration for many more decades (Wahlenberg 1930, Zavitkowski et al. 1969). The high fire intensity associated with the Wheeler Point fire essentially changed these sites, by volatizing organic material and causing other changes, to such an extent that they may no longer be hospitable to trees.

The Wheeler Point fire (figs. 2, 9, 18) demonstrates that uncharacteristic fire effects may persist on dry-forest sites for a century or more, and if we wish to maintain forest vegetation in these areas, then thinning, prescribed fire, and other practices should be utilized (fig. 19) to make them more resilient to future climate change and associated increases in wildfire occurrence (fig. 16).

This climate-change review suggests that silvicultural activities in the proposed action adequately anticipate future climate change, appropriately provide for future ecosystem resiliency and integrity, and reasonably realign existing conditions to be more sustainable under future climates (Dale et al. 2001, Janowiak et al. 2014).



Burn Severity	Acres
Unburned to Low	8,927
Low	5,912
Moderate	4,646
High	3,098
Increased Greenness	84
Non-Processing Area Mask*	0
Total	22,668

Figure 18 – Wheeler Point fire, showing pre-fire reflectance information at top (red tints denote forest or shrub cover; green tints denote herbaceous cover), and post-fire burn severity at bottom. Tree mortality is associated with moderate and high burn severity. Area above white lines includes NFS lands. MTBS is explained in Eidenshink et al. 2007.

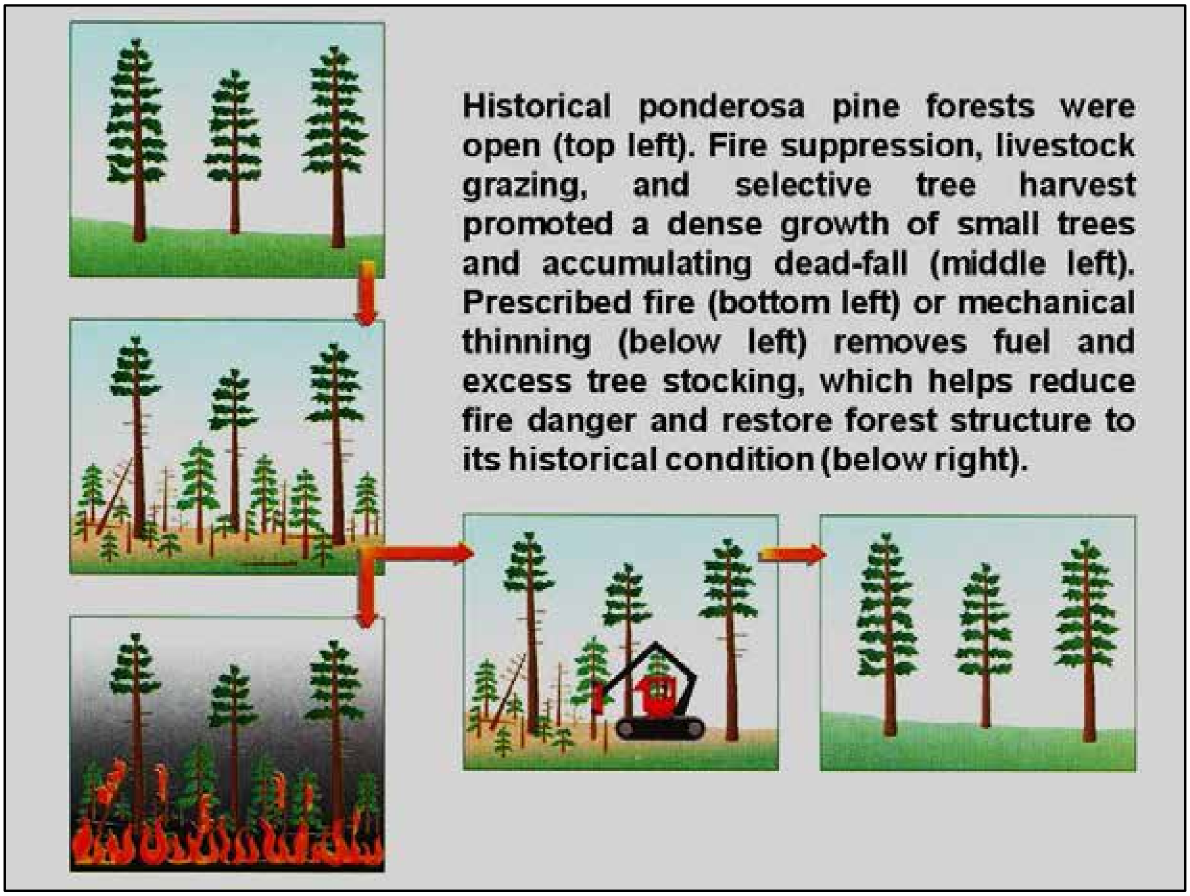


Figure 19 – Restoration objectives for the Kahler Dry Forest Restoration Project (graphic from Powell 2014a). Mechanical thinning and prescribed fire are effective treatments for addressing dry-forest ecosystem changes caused by fire exclusion, livestock grazing, and selective tree harvest (Johnson et al. 2011, McIver et al. 2013, Stephens et al. 2009, Youngblood 2010). It is becoming increasingly evident that restoration of dry forests is needed on a scale unprecedented in recent history (Franklin and Johnson 2012, USDA Forest Service 2012b). What might qualify as restoration for dry forests? I believe a successful restoration outcome for dry forests includes the following six elements, taken primarily from Agee and Skinner (2005) and Powell (2014a), but they also agree with "Restoring ecosystem health in frequent-fire forests of the American west" by W.W. Covington (2003).

1) Species composition, forest structure, and stand density occur within their historical ranges of variation.
2) Both trees and forests express indicators of high vigor, such as high sap flow, increased radial growth, good seedling height growth, and high foliar nitrogen levels.
3) Stands and landscapes have high fire resistance, high capacity to accept and absorb fire, and high capability to exhibit positive ecosystem responses to fire's ecological benefits.
4) Forests exhibit high resilience to insects and diseases at a landscape scale – individual tree stands in a landscape do experience insect and disease activity, but it occurs at characteristic levels in a landscape context.
5) Landscapes are effectively buffered for future climate change, exhibiting appropriate near-term (resistance) and long-term (resilience) adaptation to direct and indirect effects caused by warmer temperatures and reduced precipitation. Vulnerable ecosystems have received appropriate mitigation treatments to increase their survivability and persistence in a climate change context.
6) Sustainable wood product outputs are both possible and realized, contributing to socioeconomic resilience and community stability (including appropriate persistence of wood-processing infrastructure).

Figure 20 – Thinning and low-severity fire allow dominant trees to survive by reducing the risk of stand-replacing fire, while also providing high levels of carbon sequestration and minimizing greenhouse gases (images from Hurteau et al. 2008). Above: When starting with an intact forest (top), forest management (lower right) can sequester more carbon (including storage in wood products) than allowing it to burn as a stand-replacing fire (lower left). Below: Not all fire is created equal: low-severity fire (bottom) maintains high sequestration and conservation benefits, whereas high-severity fire (top) releases high amounts of greenhouse gases and results in reduced sequestration value.

Suggested Stocking Levels

In 1994, the Pacific Northwest Research Station published a peer-reviewed research note providing suggested stocking levels for upland-forest plant associations of the Blue Mountains in northeastern Oregon and southeastern Washington (Cochran et al. 1994). The research note contained an unusual amount of detail because suggested stocking levels were presented for seven tree species, and they varied across two geographical areas (Blue-Ochoco and Wallowa-Snake) and for 66 individual plant associations.

After practitioners began using the Cochran et al. (1994) research note, it became clear that additional information would help users understand and implement the suggested stocking levels. To meet this need, an 'implementation guide' was published to provide additional stocking-level information (Powell 1999). Since then, density management regimes for thinnings, improvement cuttings, and similar intermediate silvicultural treatments in the Blue Mountains have utilized the suggested stocking levels contained in Cochran et al. (1994) and Powell (1999).

This section provides suggested stocking levels for the Kahler Dry Forest Restoration Project (table 48). They are based on ponderosa pine stocking-level recommendations in Cochran et al. (1994) and Powell (1999). Suggested stocking levels are derived from stand density index (SDI), although SDI values have also been converted to basal area (feet^2/acre) to assist with preparation of silvicultural prescriptions and marking guides. Since basal area increases for the same SDI value as tree size increases, three measures of tree size are provided in table 48 – quadratic mean diameters (QMD) of 10, 15, and 20 inches.

Table 48 shows that basal area increases as QMD increases, even though all of the basal areas in a particular column pertain to a constant SDI value, which is shown in red text above them.
Note: SDI relates to a stand's leaf area, so it reflects how much growing-space is occupied by trees. For an SDI value, basal area increases as tree size (QMD) increases; this occurs because the proportion of sapwood to heartwood decreases as trees get larger (for the same proportion of sapwood, more basal area must be present in large trees than in small trees). Heartwood is non-living stem tissue providing strength and rigidity for a tree; sapwood is living stem tissue supplying canopy leaf area with water and nutrients.

Table 48: Suggested stocking levels for predominant plant associations of Kahler planning area

Potential Vegetation Type	Acres		Maximum Density	Full Stocking	Upper Limit	Lower Limit
Douglas-fir/elk sedge	4,460	SDI Value	**278**	**222**	**86**	**58**
		BAA at 10" QMD	141	113	44	29
		BAA at 15" QMD	155	124	48	32
		BAA at 20" QMD	165	132	51	35
Douglas-fir/pinegrass	8,130	SDI Value	**329**	**263**	**122**	**82**
		BAA at 10" QMD	167	133	62	42
		BAA at 15" QMD	183	146	68	46
		BAA at 20" QMD	196	156	73	49
Douglas-fir/common snow-berry	4,950	SDI Value	**341**	**273**	**151**	**101**
		BAA at 10" QMD	173	138	77	51
		BAA at 15" QMD	190	152	84	56
		BAA at 20" QMD	203	162	90	60
Grand fir/elk sedge	2,990	SDI Value	**263**	**210**	**109**	**73**
		BAA at 10" QMD	133	107	55	37
		BAA at 15" QMD	146	117	61	41
		BAA at 20" QMD	156	125	65	43

Potential Vegetation Type	Acres		Maximum Density	Full Stocking	Upper Limit	Lower Limit
Grand fir/pinegrass	1,310	SDI Value	**395**	**316**	**154**	**103**
		BAA at 10" QMD	200	160	78	52
		BAA at 15" QMD	220	176	86	57
		BAA at 20" QMD	235	188	92	61
Ponderosa pine/elk sedge	1,090	SDI Value	**251**	**201**	**82**	**55**
		BAA at 10" QMD	127	102	42	28
		BAA at 15" QMD	140	112	46	31
		BAA at 20" QMD	149	120	49	33
Ponderosa pine/bitterbrush/ Idaho fescue-bluebunch wheatgrass	1,980	SDI Value	**231**	**185**	**66**	**44**
		BAA at 10" QMD	117	94	33	22
		BAA at 15" QMD	129	103	37	24
		BAA at 20" QMD	137	110	39	26

Notes: BAA is basal area per acre (feet^2/acre); QMD is quadratic mean diameter (tree diameter corresponding to the mean basal area); SDI is stand density index (Reineke 1933), which relates existing stand density to an equivalent number of trees per acre at a QMD of 10 inches. These stocking levels are derived from the ponderosa pine information contained in Cochran et al. (1994) and Powell (1999); those sources describe the four stocking levels included in this table; 'upper limit' and 'lower limit' relate to the upper and lower limits of a management zone. Note that for variable-density thinning, residual basal-area values will fall somewhere between the upper and lower limit values – lower limit basal-area values are minimum amounts to be retained, not necessarily an objective. **Important Note**: Stocking levels in this table are conservative because they pertain to an even-aged structure; they should be reduced by 7% for an irregular structure, or by 13% for an uneven-aged structure, and either of these structures is more appropriate for dry forests (historically) than an even-aged structure (Powell 2014a).

An important goal of the Kahler project is to sustain productive forest conditions. Maintaining appropriately open stand conditions is consistent with historical stand conditions (fig. 17), and with the prevailing soil type in the Kahler planning area – Mollisols, which develop in grassland or forest-savanna environments (Archuleta 2014). The stocking levels presented in table 48 are also forward-looking because they will help protect soil and site productivity during a future when increased fire occurrence (fig. 16) is expected to frequently remove litter, duff, and other soil-protective organic matter.

Maintaining intact forest ecosystems (fig. 20) under future warmer and dryer conditions, which is an expected outcome of applying the stocking levels in table 48, will restore litter and duff layers more quickly than would occur in the absence of properly functioning forest cover.

This passage illustrates the importance of sustaining forest cover as a way to provide soil protection, and it also demonstrates how long the relationship between forest cover and soil productivity has been recognized for a portion of the Umatilla NF containing the Kahler planning area (Langille 1903a):

> "The beneficial effect of the forest cover on these lands cannot be overestimated. Under climatic conditions such as those described, the soil is subjected to destructive washing and erosion, particularly during the terrific downpours which accompany the electrical storms referred to. As an evidence of this force, it was everywhere observed that upon tracts upon which there is no forest cover there is no soil. The scab lands referred to are startling illustrations of this erosion. At one time these areas were covered with soil to a depth of from one to two feet, and sufficient soil binding vegetation grew upon it to resist the destructive elements – wind and water – but persistent overgrazing destroyed this cover, and, there being no tree growth to protect the soil, it rapidly disappeared, leaving nothing but a bed of exposed rocks, upon which almost nothing grows. Frequently there may be seen small beds of soil surmounted by resistant forms of vegetation which have held the soil intact and now remain as striking illustrations of the necessity for the perpetuation of the soil cover to prevent the entire mountain slopes from becoming barren wastes of rock."

Other Relevant Mandatory Disclosures

Consistency of Proposed Silvicultural Activities with Eastside Screens

In March 1993, the Natural Resources Defense Council (NRDC) petitioned the U.S. Forest Service (Pacific Northwest Region) to halt all timber harvest activity in old growth forest occurring on national forest lands located east of the Cascade Mountain crest in Oregon and Washington (this geographical area is also known as the Eastside).

A month later in April 1993, a group of university and U.S. Forest Service research scientists released an "Eastside Forest Ecosystem Health Assessment" in draft form; this assessment is known as the "Everett Report" because it was directed by Dr. Richard Everett, a scientist located at the Wenatchee Forestry Sciences Laboratory (Everett et al. 1994).

In response to both the NRDC petition and the Everett report, the Pacific Northwest Region of the U.S. Forest Service issued interim direction in August 1993 requiring that timber sales prepared and offered by Eastside national forests be evaluated to determine their potential impact on riparian habitat, historical vegetation patterns, and wildlife fragmentation and connectivity.

This interim direction, known as the Eastside Screens, was used to amend Eastside forest plans when Regional Forester John Lowe signed a Decision Notice on May 20, 1994 to implement Regional Forester's Forest Plan Amendment #1 (USDA Forest Service 1994). Regional Forester's Forest Plan Amendment #1 is amendment #8 to the Umatilla National Forest Land and Resource Management Plan.

A slightly revised version of the Eastside Screens was issued as Regional Forester's Forest Plan Amendment #2 when Regional Forester John Lowe signed a Decision Notice on June 12, 1995 (USDA Forest Service 1995). Regional Forester's Forest Plan Amendment #2 is amendment #11 to the Umatilla National Forest Land and Resource Management Plan.

The Eastside Screens consist of six items: three general items (items 1 to 3), a riparian standard (item 4), an ecosystem standard (item 5), and a wildlife standard (item 6). This section describes how proposed silvicultural activities for the Kahler Dry Forest Restoration Project comply with the Eastside Screens.

General Standards (items 1-3 in FP Amendment #11)

Item 1 defines the scope of the Eastside Screens to be timber sales only.

> **Finding**: The Kahler proposed action includes intermediate silvicultural activities such as thinning. In some portions of the planning area, these activities will be implemented by using a commercial timber sale contract. Since item 1 defines the scope of the Eastside Screens to be timber sales only, and because a timber sale contract will be used to implement some of the silvicultural activities included in the Kahler proposed action, this means that *the Kahler Dry Forest Restoration Project must comply with the Eastside Screens*.

Item 2 exempts personal-use firewood sales, post and pole sales, sales to protect health and safety, and sales within recreation special use areas from the amendment.

> **Finding**: It is not anticipated that personal-use firewood sales, post and pole sales, sales to protect health and safety, or sales within recreation special use areas will be used to implement the proposed silvicultural activities, so *item 2 does not apply to the Kahler Dry Forest Restoration Project*.

Item 3 exempts five categories of timber sales from the ecosystem standard (but not from the riparian and wildlife standards):

- Precommercial thinning;
- Material sold as fiber;
- Dead material less than 7 inches in diameter, with incidental green volume;
- Salvage sales located outside mapped old growth, with incidental green volume; and
- Commercial thinning and understory removal sales located outside mapped old growth.

The Kahler intermediate silvicultural activities (such as variable-density thinning, the ICO method, and shrub-steppe enhancement thinning) qualify for an exemption from the ecosystem standard because they are "commercial thinning and understory removal sales located outside mapped old growth" (the fifth category of timber sales included in item 3).

Note: "Mapped old growth" is defined to include both of the Forest Plan allocations for old growth (C1 and C2), as they are depicted on published maps distributed with the Forest Plan (USDA Forest Service 1990), or as these maps have been amended since 1990 (the location of C1 areas was changed in the vicinity of large wildfires). This definition for mapped old growth follows written guidance and direction from the Pacific Northwest Region "Eastside Screens Oversight Team" (Lowe 1995).

However, direction from the Pacific Northwest Regional Office states that it is not mandatory to exempt "commercial thinning and understory removal sales" from the ecosystem standard and it further notes that in some circumstances, it may be advantageous to project viability to not exempt them (Lowe 1995).

> **Finding**: The majority of the intermediate silvicultural activities described in the proposed action (including upland-forest commercial thinning) are contained in the land base used for the historical range of variation (HRV) analysis for the Kahler Dry Forest Restoration Project, so there is no need to exempt them from the ecosystem standard, and *an exemption is not claimed for any commercial thinning and understory removal treatments occurring on the Dry Upland Forest biophysical environment (e.g., the Dry Upland Forest PVG)*.

The Moist Upland Forest biophysical environment (PVG) has too few acres in the Kahler forest vegetation affected environment for a credible HRV analysis – the Moist UF PVG only occupies 380 acres of the Kahler planning area, and only 300 acres of this amount occurs in the forest vegetation affected environment. An HRV analysis is not completed for any biophysical environment occupying less than 1,000 acres within an HRV analysis area (Powell 2014b).

Note: for the HRV analyses described in this section, and throughout this Forest Vegetation Report, potential vegetation groups (Powell et al. 2007) are used as biophysical environments. Two upland-forest potential vegetation groups exist in the Kahler planning area (tables 3 and 4) – dry upland forest and moist upland forest. Since moist upland forest has less than 1,000 acres in the planning area, all of the HRV analyses presented in this report pertain to one biophysical environment only – dry upland forest.

However, about 150 acres of Moist UF PVG are intermingled within dry upland-forest commercial thinning units associated with the Kahler proposed action: of the app. 10,000 acres of upland-forest commercial thinning associated with alternative 2 (table 1), app. 150 acres (1.5%) are Moist UF and app. 9,850 acres (98.5%) are Dry UF.

> **Finding**: Since the Moist UF treatment acreage comprises a very small proportion of the total commercial thinning acreage (about 1.5%), and because the Moist UF treatments involve "commercial thinning and understory removal" treatments, and since claiming an exemption for "commercial thinning and understory removal sales located outside mapped old growth" will preclude the need for Moist UF acreage to be considered in an HRV analysis, *an exemption from the ecosystem standard is hereby claimed for the Moist UF treatment acreage included in the Kahler proposed action*.

Note: another alternative for evaluating HRV for Moist UF acreage is to establish a separate HRV analysis area for the Moist UF biophysical environment (BE), and have it extend considerably beyond the Kahler planning area boundary in order to encompass at least 1,000 acres of Moist UF acreage. Since the small amount of proposed treatment on Moist UF acreage involves commercial thinning (an allowable treatment for the fifth exemption category), claiming this exemption is more reasonable than establishing a separate HRV analysis area just for the Moist UF BE.

Also, about 130 acres of "juniper thinning and shrub-steppe enhancement" silvicultural activity (table 1) is associated with nonforest or woodland vegetation types, and its manipulation is included in both alternatives 2 and 3 (table 52). Although nonforest (shrubland/herbland) and woodland PVGs have been described for the Blue Mountains (Powell et al. 2007), ranges of variation have not been established for these biophysical environments (Martin 2010) and they are not included in the Kahler HRV analyses.

> **Finding**: Since the "juniper thinning and shrub-steppe enhancement" activity occurs outside mapped old growth, and because commercial wood products (if any) derived from this activity are associated with the "commercial thinning and understory removal" treatments referred to as upland-forest commercial thinning in table 1, then *an exemption is also claimed for "juniper thinning and shrub-steppe enhancement" treatments included in commercial timber sale or stewardship contracts and occurring on nonforest or woodland biophysical environments in the Kahler planning area*.

Riparian Standard (item 4 in Forest Plan Amendment #11)

Item 4 of the Eastside Screens directs that timber sales (green and salvage) will not be planned or located in riparian areas.

Forest Plan amendment #10, commonly referred to as PACFISH, is interim direction designed to "arrest the degradation and begin the restoration of aquatic habitat and riparian areas on lands administered by the Forest Service and BLM; it applies to watersheds outside the range of the northern spotted owl that provide habitat for Pacific salmon, steelhead, and sea-run cutthroat trout."

Umatilla National Forest policy is that amendment #10 (USDA Forest Service and USDI Bureau of Land Management 1995) to the Land and Resource Management Plan will be applied in lieu of the riparian standard from the Eastside Screens.

> **Finding**: This policy means that *using PACFISH also meets the Eastside Screens riparian standard*.

PACFISH uses a buffer concept to establish riparian habitat conservation areas (RHCA) along both sides of streams, rivers, lakes and other wetlands. RHCA widths extend from the edge of the active stream channel and they vary with stream class and whether a stream is fish bearing or not.

RHCAs can be established using specified feet of slope distance (such as 300 feet on either side of perennial, fish-bearing streams) or in numbers of "site potential tree heights" (such as 2 site-potential tree heights for perennial, fish-bearing streams).

The interim RHCA widths established by the PACFISH environmental assessment could be adjusted during watershed analysis or after site-specific analysis presenting a rationale for RHCA modifications.

Timber management has one standard, TM-1, in the PACFISH amendment; it is quoted below in its entirety (see page C-10 in USDA Forest Service; USDI Bureau of Land Management 1995):

"Prohibit timber harvest, including fuelwood cutting, in Riparian Habitat Conservation Areas, except as described below. Do not include Riparian Habitat Conservation Areas in the land base used to determine the Allowable Sale Quantity, but any volume harvested can contribute to the timber sale program." [This statement renders PACFISH RHCAs as unsuitable in a Forest Plan context.]

a. "Where catastrophic events such as fire, flooding, volcanic, wind, or insect damage result in degraded riparian conditions, allow salvage and fuelwood cutting in Riparian Habitat Conservation Areas only where present and future woody debris needs are met, where cutting would not retard or prevent attainment of other Riparian Management Objectives, and where adverse effects on anadromous fish can be avoided. For watersheds with listed salmon or designated critical habitat, complete Watershed Analysis prior to salvage cutting in RHCAs."

b. "Apply silvicultural practices for Riparian Habitat Conservation Areas to acquire desired vegetation characteristics where needed to attain Riparian Management Objectives. Apply silvicultural practices in a manner that does not retard attainment of Riparian Management Objectives and that avoids adverse effects on listed anadromous fish."

Finding: *One of the proposed silvicultural activities (dry forest RHCA thinning; see table 1) for the Kahler Dry Forest Restoration Project pertains to class IV riparian habitat conservation areas in the dry upland forest biophysical environment*. Refer to the dry forest RHCA thinning treatment description (pages 9-13), and the soils, fisheries, hydrology, fuels, and wildlife specialist reports (Archuleta 2014, Dowdy 2014, Farren 2014, Marshall 2014, Scarlett 2014, respectively), for more information about the ecological rationale for dry forest RHCA thinning treatments, and for explanations about how this activity relates to PACFISH standards, guidelines, and riparian management objectives.

Ecosystem Standard (item 5 in Forest Plan Amendment #11)

The ecosystem standard requires a landscape-level assessment of the historical range of variation (HRV) for structural stages, including a comparison of existing structural stage amounts with their historical ranges.

Item 5 (a) requires that we "characterize the proposed timber sale and its associated watershed for patterns of stand structure by biophysical environment and compare to the Historic Range of variation (HRV)."

Finding: *An HRV analysis for stand structure (e.g., structural stages) was completed for the proposed timber sale (Kahler Dry Forest Restoration Project), and the HRV analysis area consists of five contiguous watersheds (e.g., subwatersheds)*: Alder Creek (170702040108), Lower Kahler Creek (170702040104), Upper Kahler Creek (170702040103), Haystack Creek (170702040105), and Bologna Canyon (170702040101).

Item 5 (b) requires us to:
(1) "describe the dominant historical disturbance regime, i.e. the disturbance types and their magnitudes and frequencies;
(2) Characterize the landscape pattern and abundance of structural stages maintained by the disturbance regime. Consider biophysical environmental setting across the landscape to make this determination;
(3) Describe spatial pattern and distribution of structural stages under the HRV disturbance regime; and
(4) Map the current pattern of structural stages and calculate their abundance by biophysical environmental setting" (USDA Forest Service 1995).

Finding: *The analyses and map required by item 5 (b) are provided in tables 49 and 50, and in figure 21*.

Item 5 (c) requires that we "characterize the difference in percent composition of structural stages between HRV and current conditions."

Finding: Structural stages for the planning area are determined, and then compared with their historical ranges (e.g., HRV) by biophysical environment. *Results of the analysis are presented below in table 49*.

Table 49: Structural stage HRV analysis for the ecosystem standard from the Eastside Screens Forest Plan Amendment (pertains to Dry Upland Forest biophysical environment only)

Structural Stage	Historical Range (%)	Current Percent
Stand Initiation	15-25	19
Stem Exclusion	10-20	35
Understory Reinitiation	5-10	32
Single stratum with large trees (SSLT)	40-60	6
Multi-strata with large trees (MSLT)	5-15	9

Sources/Notes: Current percentages are summarized from the Kahler vegetation database (NFS lands only) and pertain to the forest vegetation affected environment (app. 26,980 acres of dry upland forest) (see table 12). Due to its small acreage in the planning area (380 acres total; 300 acres of the affected environment), no results are reported for the Moist Upland Forest biophysical environment. Gray shading shows late-old structural stages that are above or below the historical range of variation. Historical percentages for each biophysical environment are derived from Martin (2010).

Table 50: Biophysical environments matrix for upland forests of the Kahler analysis area

PVG	Area (Acres)	Disturbances	Fire Regime	Patch Size	Elevation (Feet)	Slope (Percent)	Dominant Aspects
Dry Upland Forest	26,980	Fire Insects Harvest	Frequent Surface	1-3,000	4,000 (3,000-5,000)	20 (5-60)	Southwest West South

Sources/Notes: Elevation, slope, and aspects are summarized from the Kahler vegetation database (NFS lands only). Patch size is taken from Johnson (1993). Fire regime name is taken from Schmidt et al. (2002).

Item 5 (c) also requires that we “identify structural conditions and biophysical environment combinations that are outside HRV conditions to determine potential treatment areas” (USDA Forest Service 1995).

Finding: Results from the structural stage HRV analysis were used when determining potential treatment areas for the Kahler Dry Forest Restoration Project. However, HRV analyses were also completed for species composition and stand density in addition to structural stages, so *potential treatment areas for the Kahler project reflect HRV results for all three of these indicators: species composition (forest cover types), forest structure (structural stage), and stand density (density classes)*.

Wildlife Standard (item 6 in Forest Plan Amendment #11)

Item 6 (a) states that the wildlife standard has two possible scenarios to follow as based on HRV results for late-old structural stages (LOS), and it defines LOS to be the ‘multi-strata with large trees’ and ‘single stratum with large trees’ structural stages.

Item 6 (b) directs that:

Scenario A (item 6 d) is to be used whenever either one of the LOS stages is below HRV. If both LOS stages occur within a single biophysical environment and one is above HRV and one below, Scenario A is to be used.

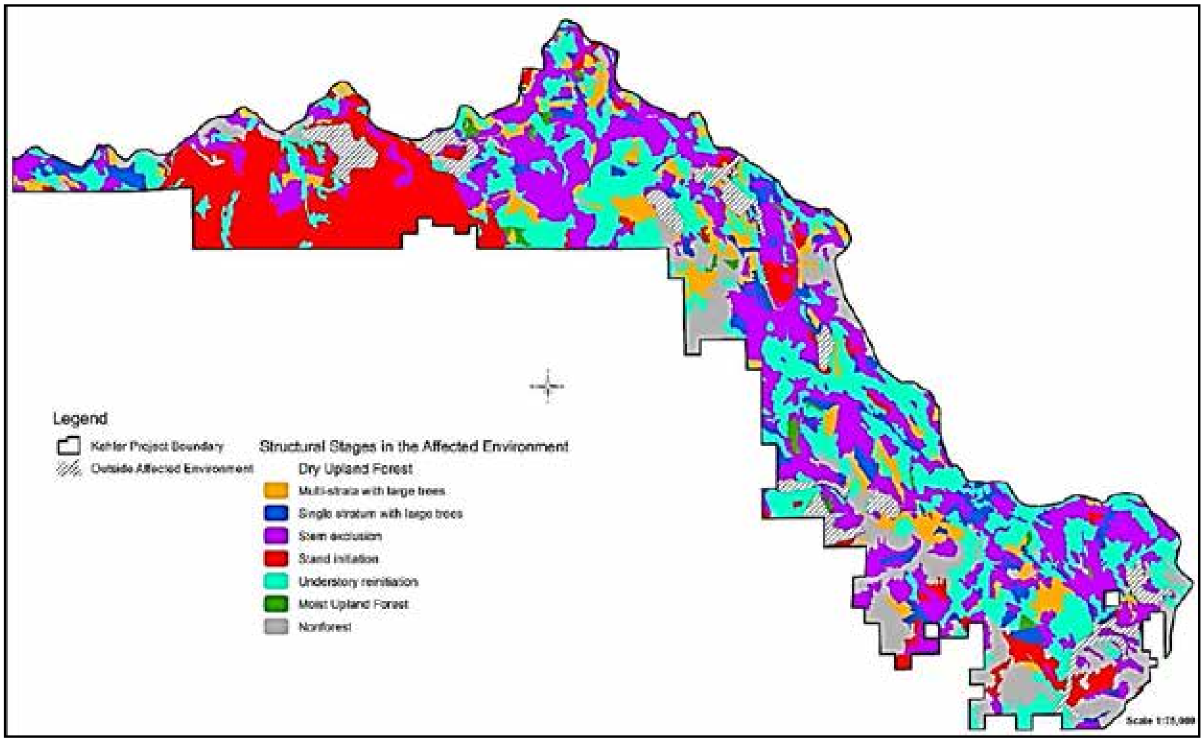


Figure 21 – Distribution of forest structural stages for the Kahler planning area (no structural stages are shown for Moist Upland Forest or Nonforest).

Scenario B (item 6 e) is to be used only when both LOS stages for a particular biophysical environment are within or above HRV.

Finding: Table 51 shows that for the dry upland forest biophysical environment, one LOS stage is within HRV (multi-strata with large trees) and the other LOS stage is outside of HRV (single stratum with large trees). According to item 6 (b) of the wildlife standard and the HRV results presented in table 50, this means that forest vegetation silvicultural activities for the Kahler Dry Forest Restoration Project must comply with: *Scenario A for the Dry Upland Forest biophysical environment.*

Table 51: HRV analysis results for late-old structure (LOS) structural stages

Biophysical Environment	Structural Stage	Historical Range (%)	Current Percent	Forest Plan Amendment 11: Wildlife Standard Results
Dry Upland Forest	SSLT	40-60	6	***Scenario A***
	MSLT	5-15	9	

Sources/Notes: Refer to table 49 for the complete structural stage analysis. Gray shading indicates late-old structural stages that are above or below the historical range of variation. Note that in table 49, the SSLT structural stage is referred to as "Single stratum with large trees" and the MSLT structural stage is referred to as "Multi-strata with large trees."

Item 6 (c) requires that any of the five timber sales exempted from the ecosystem standard (see item 3 in General Standards section above) must still meet the intent of the wildlife standards by following items 1-4 from the Scenario A direction (Scenario A is item 6 (d) of the Wildlife Standard).

Finding: As described above in the General Standards section, it is permissible to exempt the intermediate silvicultural activities (commercial thinnings) from the ecosystem standard, and an exemption is claimed, but only for Moist Upland Forest and nonforest or woodland biophysical environments. Therefore, direction in item 6 (c) requiring that exempted timber sales meet the wildlife standards contained in item 6 (d) (Scenario A, below) does apply to Moist UF sites included in either alternative 2 or alternative 3 (approximately 150 acres of Moist UF is intermingled in larger treatment units comprised primarily of Dry UF, and it is proposed for treatment in conjunction with adjoining Dry UF acreage), and to app. 130 acres of nonforest or woodland acreage affected by the 'juniper thinning and shrub-steppe enhancement' silvicultural activity described in table 1.

Item 6 (d) of the Wildlife Standard, which is Scenario A, includes four parts and many sub-parts as described below. Introductory verbiage for the Scenario A section states: "If either one or both of the late and old structural (LOS) stages falls BELOW HRV in a particular biophysical environment within a watershed, then there should be NO NET LOSS OF LOS from that biophysical environment. DO NOT allow timber sale harvest activities to occur within LOS stages that are BELOW HRV."

Since the Dry Upland Forest (Dry UF) biophysical environment must comply with Scenario A, all findings will be reported in the context of this biophysical environment.

Finding: *Some of the proposed timber harvest is inconsistent with the introductory language for item 6 (d)*, which states: "DO NOT allow timber sale harvest activities to occur within LOS stages that are BELOW HRV." The commercial thinning silvicultural activities (table 1) affect both LOS stages (table 52), although treatment of SSLT (which is below HRV) can only be authorized with a site-specific Forest Plan amendment.

Response to the Inconsistency: Treatment is proposed for some SSLT stands, but treatment will not change their LOS status (they are LOS before and after treatment). Therefore, proposed treatment meets the intent of item 6 (d) because there will be no net loss of LOS as a result of the activity.

The understory thinnings proposed for these stands are designed to improve tree vigor, and resistance to western pine beetle attack and future wildfire risk (fig. 16), thereby ensuring maintenance and persistence of the large-tree component into the future (<u>note</u>: according to structural-stage classification standards for the Blue Mountains, at least 10 trees per acre ≥ 21" dbh must be present for a stand to qualify as old forest (LOS)).

The Pacific Northwest Regional Forester (Goodman 2003) and the Umatilla NF Forest Supervisor (Blackwood 2003) encouraged us "to consider site-specific Forest Plan amendments where this will better meet LOS objectives" (Goodman 2003: page 1); a Forest Plan amendment to authorize thinning treatments in SSLT, primarily to address insect susceptibility and fire risk, agrees with the 2003 memorandums referenced above.

Part 1 of item 6 (d) states: "Some timber sale activities can occur within LOS stages that are within or above HRV in a manner to maintain or enhance LOS within that biophysical environment. It is allowable to manipulate one type of LOS to move stands into the LOS stage that is deficit if this meets historical conditions."

Finding: This item refers to LOS, and how manipulation of LOS could occur. The commercial thinning silvicultural activities (table 1) involve both LOS stages (table 52), although treatment in the SSLT LOS stage can only be authorized with a site-specific Forest Plan amendment (see finding preceding this one). Proposing timber sale activities in the MSLT stage is permissible because this LOS stage is within or above HRV (it is within HRV in this instance – see table 51), and the silvicultural activities (variable-density thinning or application of the ICO methodology) proposed for this stage are designed to maintain or enhance LOS conditions on dry sites.

Specifically, the proposed action will implement thinning (understory) treatments for 400 acres of the MSLT stage with an objective of converting it immediately to the SSLT stage – after implementation, MSLT is reduced by 400 acres, but it still occurs within its historical range of variation after this acreage reduction, and SSLT is increased by the same 400 acres (but a 400-acre increase is not enough to move SSLT within its historical range).

Table 52: Structural stages affected by silvicultural activities included in the proposed action (alternative 2)

Structural Stage	Treatment (Acres)		Comments
	Alt 2	Alt 3	
Nonforest (NF)	130	130	This treatment involves the juniper thinning and shrub-steppe enhancement activity (table 1)
Stand Initiation (SI)	160	150	This treatment primarily involves the noncommercial thinning outside of harvest units activity (table 1)
Stem Exclusion (SE)	4,510	4,280	Treatments for these structural stages involve variable-density thinning and the ICO approach on upland-forest or class IV riparian areas, including aspen restoration where appropriate (table 1)
Understory Reinitiation (UR)	4,900	4,670	
Single stratum with large trees (SSLT)	1,090	970	
Multi-strata with large trees (MSLT)	1,430	1,340	
Total	12,220	11,540	

Sources/Notes: Proposed treatment acres are summarized from the Kahler vegetation database (NFS lands only). The two structural stages with gray shading qualify as late-old structure (LOS) as defined by the Eastside Screens.

Part 2 of item 6 (d) states that many types of timber sale activities are permissible outside of LOS, with the intent of maintaining or enhancing LOS components, but that (a) "remnant late and old seral and/or structural live trees greater than or equal to 21 inches in diameter" must be maintained; that (b) manipulation of vegetative structure not meeting LOS standards should occur in such a way that conditions are moved toward LOS structure; and that (c) maintenance or restoration of open, park-like structure should be emphasized whenever appropriate.

Finding: *Some of the proposed timber harvest is inconsistent with part 2 of item 6 (d)*. Part 2 refers to three aspects of LOS components, and how they will be maintained or enhanced by proposed timber sale activities. Under normal circumstances, part 2 will result in no live trees ≥ 21 inches dbh being removed from the Dry Upland Forest biophysical environment (except for health and safety purposes such as imminent danger trees along open roads in the project area).

Response to the Inconsistency: The Kahler Dry Forest Restoration Project has a restoration emphasis, and this results in a need to remove some of the young (<150 years of age) but large (≥ 21" dbh) Douglas-fir and grand fir trees in treatment units because large numbers of young but large Douglas-firs or grand firs are inconsistent with desired future conditions for the Kahler planning area, as expressed in the project's purpose and need: "restore and promote open stands of old forest dominated by ponderosa pine, thereby moving the area toward its historical range in structure, density, and species composition" (stands containing many Douglas-firs or grand firs would not be dominated by ponderosa pine).

Since removal of some of the large, but young, Douglas-fir and grand fir trees is counter to part 2 of item 6 (d), the Kahler project includes a site-specific FP amendment to authorize their removal. The MSLT stands proposed for treatment on dry sites will receive a low thinning, a silvicultural activity designed to maintain their LOS characteristics while simultaneously converting them from MSLT, which is within its range of variation, to SSLT, which is substantially below its range of variation.

This proposal involving direct conversion of MSLT to SSLT is in agreement with part (c) of item 2: "maintenance or restoration of open, park-like structure should be emphasized whenever appropriate" (the SSLT structural stage historically featured an open, park-like structure).

Part 3 of item 6 (d) involves maintaining or enhancing the current level of connectivity between LOS stands and between Forest Plan old-growth areas, reducing fragmentation of existing LOS stands, and not applying even-aged regeneration cutting methods or group selection to non-LOS stands located within, or surrounded by, LOS stands.

Finding: This part refers to connectivity between LOS stands, and it prohibits certain cutting methods in non-LOS stands with an objective of avoiding fragmentation and maintaining connectivity. The project's wildlife biologist, line officer, timber specialist, and silviculturist reviewed activity-unit locations, juxtaposition, and proposed silvicultural prescriptions in an effort to address sub-parts contained in this part 3. As a result of the review, several units were dropped from further consideration, or the silvicultural prescription, marking guides, and other components of the design features were modified, in order to maintain or enhance existing connectivity and not contribute to future increases in fragmentation that could have a detrimental effect on existing LOS stands in the project area.

Examples of modifications resulting from this interdisciplinary review include:

(1) a site-specific FP amendment authorizing removal of large, but young, Douglas-firs and grand firs does not require that all of the qualifying trees actually be removed – wildlife considerations and input will be used to help decide which of the trees will be retained.

(2) A site-specific FP amendment to authorize understory thinning treatments in the OFSS (SSLT) structural stage will not allow any of the large, but young, Douglas-firs and grand firs to be removed, and this precautionary measure is based largely on wildlife considerations.

(3) A site-specific FP amendment to authorize understory thinning treatments in the OFSS (SSLT) structural stage will incorporate two thinning intensities – a full thinning intensity designed to reduce stand density all the way down to the lower limit of the management zone stocking level (see table 48) in order to obtain optimal insect resistance, surface fire, and climate change benefits, and a moderate thinning intensity designed to maintain higher canopy-cover levels for stands occurring in wildlife connectivity corridors.

The wildlife biologist also formulated a separate alternative (alternative 3) designed specifically to address some of the concerns contained in part 3 of item 6 (d). The Kahler project does not include any application of even-aged regeneration cutting methods or group selection (an uneven-aged regeneration cutting method). The wildlife biologist works closely during unit layout operations to help align skip locations (skips are utilized during variable-density thinning and the ICO approaches) with connectivity objectives.

Part 4 of item 6 (d) involves (a) provision of snags, green-tree replacements, and down logs; and (b) maintenance of goshawk habitat by requiring protection of every known goshawk nest (both active and historical), requiring 30 acres of goshawk nesting habitat surrounding all active and historical goshawk nest trees, and provision of a 400-acre 'post fledging area' around every known active nest site.

Finding: The project's design features and management requirements stipulate that snags and replacement tree numbers will meet or exceed Forest Plan standards. Snag abundance on the landscape was evaluated by completing FVS modeling and by referring to other information sources (Justice 2014), and existing snag conditions were compared to reference data from DecAID. For specific details about the snags, replacement trees, and down logs items, see the wildlife specialist report (Scarlett 2014).

According to the wildlife specialist report, there are no known goshawk nests in the Kahler planning area. If a nest is discovered during project preparation or implementation, most-suitable nesting habitat and post-fledging area standards from this portion of the Wildlife Standard will be applied then.

Item 6(e), which is scenario B of the wildlife standard, has four requirements. Since the Dry Upland Forest biophysical environment must comply with Scenario A, not with Scenario B, no further discussion of Scenario B will occur in this specialist report.

Forest Plan Amendment Related to Eastside Screens Wildlife Standard

The Eastside Screens, which are Amendment #11 to the Umatilla National Forest Land and Resource Management Plan (USDA Forest Service 1995), have gone through several iterations since their inception as interim direction in 1993. In 2003, after 10 years of Screens implementation, the Regional Forester examined whether the Eastside Screens were functioning as intended (Goodman 2003).

"Practical experience in trying to meet these objectives, however, has sometimes presented challenges. A recent survey of eastside Forest Silviculturists revealed that the interpretation of screens direction, including 21-inch diameter limitations, no harvest in stands below HRV (Scenario A), and prescriptive connectivity corridors, is limiting their ability to meet the screens objectives of providing LOS stands – particularly drier LOS single-story ponderosa pine or western larch stands.

I therefore encourage you to consider site-specific Forest plan amendments where this will better meet LOS objectives by moving the landscape towards HRV, and providing LOS for the habitat needs of associated wildlife species. [The memo mentions pygmy nuthatch, white-headed woodpecker, pileated woodpecker, and flammulated owl as wildlife species of particular concern.] The enclosure provides examples of when this may be appropriate. The objective of increasing the number of large trees and LOS stands on the landscape remains. Economic considerations are important but are not considered adequate justification alone for conducting harvest activities in LOS stands" (Goodman 2003).

This section provides rationale for amending the wildlife portion of the Eastside Screens amendment to the Forest Plan (specifically item 6 d, Scenario A); Scenario A refers to situations where one or both of the late-old structure (LOS) components are below HRV. The amendment authorizes two actions:

1) Some of the large, but young, Douglas-fir and grand fir trees that are ≥ 21" dbh, but less than 150 years abh, will be removed from any of the structural stages being treated, ***except for units classified as the old forest single stratum structural stage*** (OFSS); table 52, presented earlier in this report, summarizes proposed treatment by alternative and structural stage.
2) Thinning treatments will occur in a structural stage called OFSS, which is below HRV (OFSS is called "single stratum with large trees" in the Screens); thinnings will only remove trees < 21" dbh, and there will be no net loss of late-old structure (LOS) following treatment (e.g., treatment units classify as OFSS structure before entry, and they will classify as OFSS structure after entry).

This site-specific FP amendment modifies language from the Eastside Screens in the following way (language and formatting are taken directly from the Eastside Screens amendment to the Umatilla NF Forest Plan; changes to the original language are shown in red font):

d. Scenario A

If either one or both of the late and old structural (LOS) stages falls BELOW HRV in a particular biophysical environment within a watershed, then there should be NO NET LOSS OF LOS from that biophysical environment. ~~DO NOT allow timber sale harvest activities to occur within LOS stages that are BELOW HRV~~.

1) Some timber sale activities can occur within LOS stages that are within or above HRV in a manner to maintain or enhance LOS within that biophysical environment. It is allowable to manipulate one type of LOS to move stands into the LOS stage that is deficit if this meets historical conditions.
2) Outside of LOS, many types of timber sale activities are allowed. The intent is still to maintain and/or enhance LOS components in stands subject to timber harvest as much as possible, by adhering to the following standards:
   a) Maintain all remnant late and old seral and/or structural live trees ≥ 21" dbh that currently exist within stands proposed for harvest activities, except for some of the Douglas-fir and grand fir trees that are ≥ 21" dbh and < 150 years abh.
   b) Manipulate vegetative structure that does not meet late and old structural (LOS) conditions (as described in Table 1 of the Ecosystem Standard), in a manner that moves it towards these conditions as appropriate to meet HRV.
   c) Maintain open, park-like stand conditions where this condition occurred historically. Manipulate vegetation in a manner to encourage the development and maintenance of large diameter, open canopy structure. (While understory removal is allowed, some amount of seedlings, saplings, and poles need to be maintained for the development of future stands).

Rationale for Removing Trees Greater Than 21-inches in Diameter

There will be an option to remove some of the young grand fir and Douglas-fir trees that are over 21" dbh and interacting with a desirable tree. This option refers to young but large grand fir and Douglas-fir trees (e.g., those grand fir and Douglas-fir trees < 150 years abh and ≥ 21" dbh) and located within a distance equal to or less than 2 driplines (twice the dripline distance) from a desirable tree.

A desirable tree is defined as those trees whose retention will contribute to the Purpose and Need for the Kahler Dry Forest Restoration Project. Desirable trees occur in the following species preference (from most desirable to least desirable): any live tree ≥ 21" dbh and ≥ 150 years abh, ponderosa pine, western larch, Douglas-fir, [Engelmann spruce], grand fir, [lodgepole pine], and western juniper; on dry-forest sites, the tree species in brackets are uncommon and typically associated only with seeps and other moist microsites. A desirable tree also possesses a vigor level, and a lack of insect or disease activity, suggesting it could survive for at least 10 more years.

Occasionally, a desirable tree is ≥ 150 years abh but < 21" dbh. For some of these situations, young but large grand fir and Douglas-fir trees (e.g., those grand fir and Douglas-fir trees < 150 years abh and ≥ 21" dbh) will be cut and removed from within a distance equal to or less than 2 driplines (twice the dripline distance) from a tree greater than 150 years abh, but less than 21" dbh, when it qualifies as desirable.

Because this portion of the proposed site-specific FP amendment will not result in all of the young but large grand fir and Douglas-fir trees being removed, a decision about which of the candidate trees to remove from within a 2-dripline distance of a desirable tree will incorporate wildlife considerations (see Scarlett 2014), and they will be incorporated in the marking guides being used by crews completing timber designation activities for the Kahler Dry Forest Restoration Project.

"Restoring species composition towards historical levels can often mean removing large but younger (<150 year) grand/white fir and Douglas-fir to favor pines and western larch. Hard diameter limits, such as a 21-inch dbh limit, can make it difficult or impossible to achieve desired composition in many Mixed-Conifer Forests, which would compromise their future resilience" (Franklin et al. 2013: 74).

This passage (quoted material) is taken from a new field guide entitled: "Restoration of dry forests in eastern Oregon: A field guide" by Jerry Franklin, Norman Johnson, Derek Churchill, Keala Hagmann, Debora Johnson, and James Johnston (published in July 2013 by The Nature Conservancy; 202 p.). It is expected that this dry-forest guide will be used to inform ongoing and future planning efforts for dry-forest ecosystems, particularly since influential eastern Oregon stakeholders were involved in the guide's development and they continue to participate actively in dry-forest planning processes.

The dry-forest restoration guide goes on to state: "The most important goal is to restore Dry Forests, and their associated meadows and seeps, over large areas. If that means slightly modifying your prescription to improve the economic viability of the sale, such modest changes (i.e., within limits as described above) are likely to be worth the ecological cost" (Franklin et al. 2013: 111).

The proposed amendment is to remove some of the young grand fir and Douglas-fir (< 150 years) over 21" dbh in dry-forest treatment units. It is primarily directed toward the ecological objective stated in the Purpose and Need for the Kahler Dry Forest Restoration Project: "Restore and promote open stands of old forest dominated by ponderosa pine, thereby moving the area toward its historical range in structure, density, and species composition."

A proposed action in the Kahler Dry Forest Restoration Project involving removal of some live trees ≥ 21" dbh is not consistent with the Forest Plan, as amended by the Eastside Screens, which is one reason for this amendment. However, this site-specific FP amendment is viewed as being entirely consistent with the overall intent of the Eastside Screens to maintain or enhance existing LOS conditions.

Amending the Forest Plan to set aside the "hard diameter limit" (21" dbh) requirement from the wildlife portion of the Eastside Screens, as recommended above in the quoted passage from Franklin et al. (2013), will also contribute to ecological resilience and socioeconomic objectives of the Kahler Dry Forest Restoration Project.

The dry-forest restoration guide also states, in the Apply Marking Guidelines section: "Retention of all older trees: in addition to retaining older trees we recommend removing fuels and competing vegetation from an area around the trees extending out about 2X the dripline of the old tree canopies; highly desirable structures within the dripline, such as an outstanding younger pine, can be marked for retention" (Franklin et al. 2013: 120). Other references to using a fuels and competing vegetation distance of twice the dripline distance are also found in the dry-forest restoration guide (see page 139, and others).

Marking guidance from the dry-forest guide also states that a desirable tree may consist of a smaller ponderosa pine (such as a 16-inch tree qualifying as "an outstanding younger pine"), in which case some of the younger but large grand fir and Douglas-fir trees will be removed from a distance of twice the dripline of old tree canopies, even when the desirable tree is smaller than 21" dbh (such as the 16-inch pine example); generally this option will be used when smaller pines are old (> 150 years abh). Judgment will be used when retaining old trees less than 21" dbh – a long-suppressed grand fir sapling that is 160 years abh will generally not be retained, or at least its retention will not be based primarily on age.

Rationale for Using an Age Threshold of 150 Years at Breast Height to Identify Old Trees

In the context of identifying old trees, Forest Service managers are actively moving away from diameter-based criteria (e.g., Eastside Screens) to age-based standards. One example of this evolution is provided by the "Blue Mountains National Forests Proposed Revised Land Management Plan" (USDA Forest Service 2014). This draft revision of Land and Resource Management Plans for Blue Mountains national forests provides a desired condition (DC) for identification of individual old trees (as distinguished from identification of old forest stands) in section 2.2.2 (USDA Forest Service 2014, p. 53):

2.2.2 Individual Old Trees
Desired Condition: Individual live old trees are maintained both within and outside of old forest stands to meet a wide variety of ecological and social values. For most tree species, certain physical tree characteristics can be used to infer old age. Old age for most tree species is generally considered to be greater than 150 years in age. However, old tree characteristics and old age may vary by species and site. A description of these characteristics and age should be further developed on a site-specific project basis.

This desired condition from the revised Forest Plan uses age ("greater than 150 years in age") instead of diameter as the standard for identifying old trees. The Kahler Dry Forest Restoration Project proposes to do the same by amending the Eastside Screens portion of the existing Forest Plan to allow an age of 150 years abh to be used for old-tree determinations in lieu of the Screens' 21-inch diameter requirement. The site-specific FP amendment agrees with the draft DC above to develop this guidance on a project basis.

An important reason for using age as a criterion for identifying old trees is that diameter is known to be a poor proxy for tree age (Van Pelt 2008), both at a broad scale and at the project scale (fig. 22). Diameter limits (such as the 21" dbh standard established by the Eastside Screens) are viewed as operationally desirable because tree diameter is objectively and quickly determined in the field by measuring it with a steel diameter tape; obtaining an objective estimate of tree age, however, involves coring a tree with an increment borer, and this requires substantially more time and effort than measuring tree diameter.

Another reason for moving away from the 21" diameter limit is that it does not prohibit removal of small, but old, trees. Recent science suggests that old trees are an important ecosystem component (Franklin et al. 2008, 2013; Van Pelt 2008), and their ecological value tends not to be size-specific – a 16" dbh tree that is 150 years old has just as much 'value' as a 22" dbh tree that is 150 years old, but the Eastside Screens require that the 22" dbh tree be retained, and they do not prohibit removal of the 16" dbh tree.

Regardless of desires related to objectivity or operational simplicity, more than 20 years of experience with the Eastside Screens 21" diameter limit has clearly shown that tree size is generally a poor surrogate for tree age (Van Pelt 2008) (fig. 22), so:

A 21" dbh standard can effectively identify *large trees* (depending on how 'large' is defined), but
A 21" dbh standard cannot effectively identify <u>old trees</u>.

Stakeholders and collaborative groups also recognize the importance of using age, rather than diameter, as a metric to identify mature and old trees. This sentiment is expressed well in the following passage describing recent collaboration on the Soda Bear project in Grant County, Oregon, where 20,000 acres of forest restoration treatments were proposed in a planning area comprised primarily of dry upland forests. The collaboration involved Blue Mountains Forest Partners (a collaborative group headquartered in John Day, Oregon), the USDA Forest Service (Malheur National Forest), and two university professors from the University of Washington and Oregon State University (Brown 2012).

> "Of particular importance to the BMFP [Blue Mountains Forest Partners] was the treatment and retention of mature and old-growth tree species: on the Malheur National Forest, harvest rules prohibit the removal of living trees 21 inches in diameter at breast height (dbh) or greater. This requirement restricts the removal of young, but large, tree species such as grand fir (*Abies grandis*), and did not prohibit the removal of small, but old, trees. Predictably, this rule also reduced the amount of timber volume that could be harvested in an ecologically sensitive way, a significant issue in the economically depressed community. In an attempt to address these rule-based shortcomings, Franklin and Johnson [see Franklin and Johnson 2012] recommended adapting a set of guidelines designed to distinguish old from large trees. This guide (Van Pelt 2008) uses environmental conditions and external characteristics to estimate tree age classes. Throughout this

process, the BMFP supported the multitiered approach of Franklin and Johnson, and was particularly interested in how the new age-sensitive marking guidelines would have the desired outcome of protecting mature and old-growth pine, Douglas-fir (*Pseudotsuga menziesii*), and western larch (*Larix occidentalis*), while allowing the harvest of large, young grand fir or would simply constrain management further" (Brown 2012).

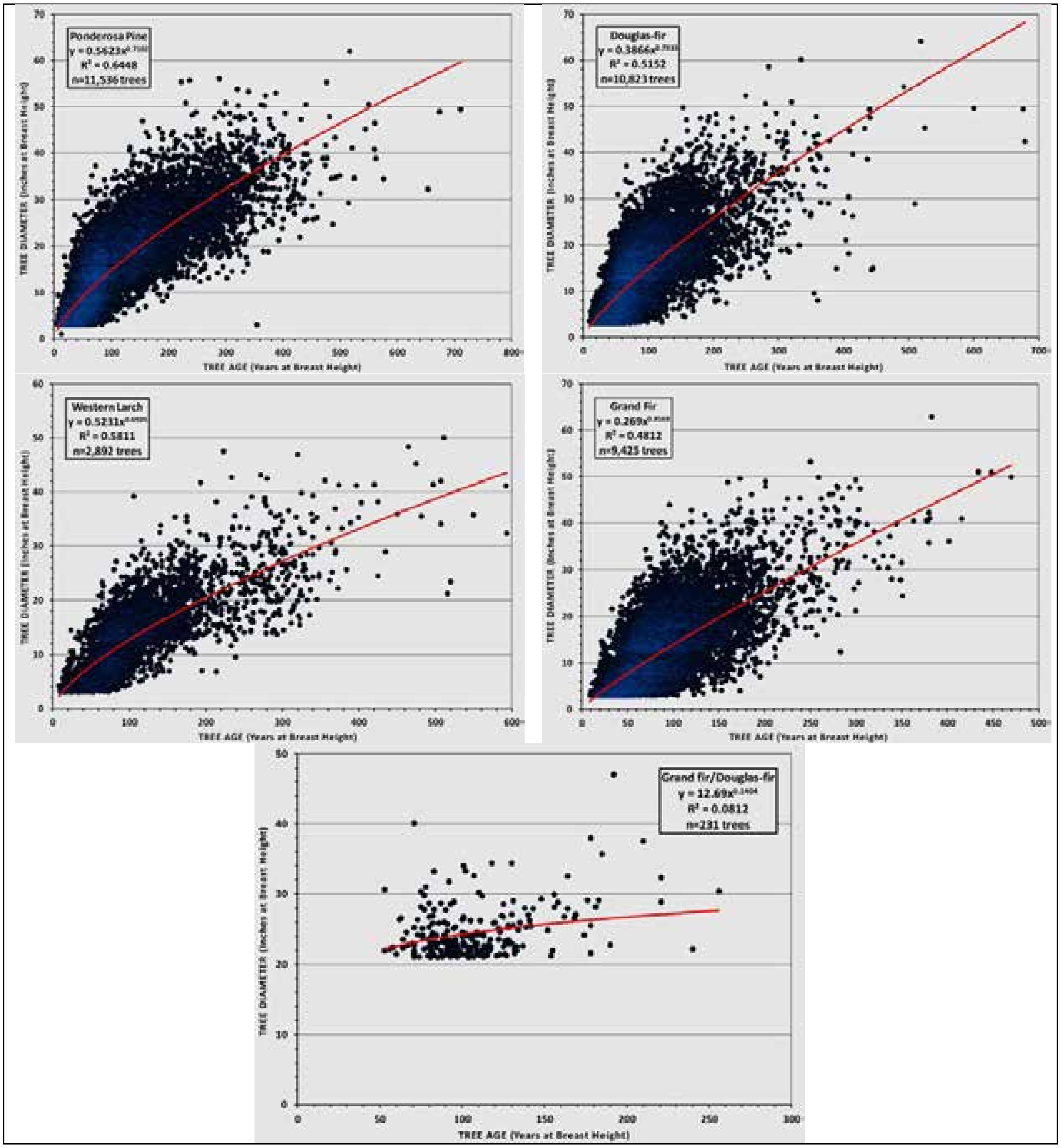


Figure 22 – Age-diameter regressions for trees occurring in the Blue Mountains. A regression utilizing tree records with measured age and dbh values from Current Vegetation Survey plots for the Blue Mountains (42,464 total records) was completed for each species. Species shown here are common in the Kahler planning area – ponderosa

pine, Douglas-fir, western larch, and grand fir (top four images). The bottom image shows a regression based on 231 cored trees from unit 57a in Kahler (mix of grand fir and Douglas-fir only; all cored trees were ≥ 21" dbh).

The information presented in figure 22 was derived from Current Vegetation Survey (CVS) plots distributed across all three of the Blue Mountains national forests. More than two thousand CVS plots exist, in total, across the three national forests; only those CVS plots supporting forest ecosystems were used in the analysis. Tree records from occasion 1 surveys completed generally between 1993 and 1996 are reflected in figure 22. After extracting tree records with measured values of diameter and age (42,464 records involving 13 tree species), records for the four most common species occurring in the Kahler planning area were used for a regression (trend-line) analysis in the Excel® spreadsheet application.

In the trend-line analyses, the independent (x-axis) variable is tree diameter; the dependent (y-axis) variable is tree age. Data points consisting of tree diameter and tree age measurements, as stratified by tree species, were plotted as a scatter (X-Y) chart. Excel provides at least half a dozen trend-line alternatives; a variety of options were examined, and one option (power function, a nonlinear alternative) was selected for all species because it tended to produce the highest coefficient of determination (R^2) value. Note that the power function did not necessarily produce the highest value for every species, but overall it provided the best fit so it was used for all species in the interest of consistency.

Results from the regression (trend-line) analyses are presented in a box in the upper left corner for each species included in figure 22 – information in the box includes a species name, an equation relating tree age (y) to tree diameter (x), the coefficient of determination (R^2) value, and the number of tree records used for the regression (n value). Note that R^2 values are always positive, indicating that there is a positive association between the independent variable (tree diameter) and the dependent variable (tree age).

Note, however, that the relationship between tree diameter and age is probably not a causal relationship (it is not a cause-and-effect relationship), but likely reflects a mutual interaction between these two variables. Rather than tree diameter **causing** variation in tree age, it is more reasonable to think of these two attributes varying together, and not representing a one-way causal relationship (Kent and Coker 2002).

Trend-line analyses presented in figure 22 have the following results:
- Ponderosa pine: R^2 value of 0.6448 for 11,536 measured trees ranging from 1 to 62.0" dbh.
- Douglas-fir: R^2 value of 0.5152 for 10,823 measured trees ranging from 3 to 64.1" dbh.
- Western larch: R^2 value of 0.5811 for 2,892 measured trees ranging from 3 to 50.0" dbh.
- Grand fir: R^2 value of 0.4812 for 9,425 measured trees ranging from 3 to 62.9" dbh.
  Note: When comparing two variables, an R^2 value is used to estimate how much variation in a dependent variable can be attributed to the independent variable. For ponderosa pine, for example, 64.48% of variation in tree age is explained by tree diameter. The remainder of tree-age variation (35.52%) is apparently related to factors other than tree diameter.

Recent science-based recommendations (Franklin and Johnson 2012; Franklin et al. 2008, 2013; Hessburg and Agee 2003; and many others) emphasize retention of trees greater than 150 years of age because these trees established before extensive Euro-American settlement and associated changes caused by fire exclusion, livestock grazing, selective timber harvest, and climate change (Powell 2014a). In addition, trees in dry forests have been observed to begin exhibiting many of the structural and functional characteristics of 'old growth' by 150 years (Franklin and Johnson 2012, Franklin et al. 2008, Van Pelt 2008).

Note that science literature citations in the previous paragraph are much more recent than the Umatilla NF Forest Plan approved in 1990 (USDA Forest Service 1990), and also more recent than the Eastside Screens approved in 1994 and 1995 (USDA Forest Service 1994, 1995). This demonstrates that Blue Mountains national forests Forest Plans, which were approved 20-24 years ago and based primarily on science developed from the late 1970s to the late 1980s, are considered to be outdated by many stakeholders (Brown 2012) and agency employees.

How do we intend to identify trees greater than 150 years of age for the Kahler Dry Forest Restoration Project? A recent field guide (Van Pelt 2008) uses a variety of morphological characteristics (e.g., bark condition, knot indicators, crown form, etc.) to identify an approximate age for ponderosa pines, Douglas-firs, and western larches growing in eastern Washington. The Van Pelt (2008) guide does not include an age-evaluation protocol for grand fir, another common tree species in the Kahler planning area.

The geographical context for the Van Pelt (2008) guide is eastern Washington. The Umatilla National Forest contains lands located in eastern Washington: the Pomeroy Ranger District, one of four ranger districts on the Umatilla NF, occurs entirely within the state of Washington (the Walla Walla Ranger District also contains lands in Washington). My experience is that vegetation and ecological conditions in southeastern Washington (where the Pomeroy and Walla Walla RDs occur) are similar to those in northeastern Oregon where the Kahler planning area occurs. A recent assessment of Umatilla National Forest resource conditions corroborates my experience and assertion (Christensen et al. 2007).

Therefore, an old-tree identification field guide developed for eastern Washington (Van Pelt 2008) is considered to be entirely appropriate for use in adjoining areas of northeastern Oregon, including the Kahler planning area.

When implementing the Van Pelt (2008) field guide, users make estimates for three or more categories of tree characteristics (such as lower trunk bark condition, knot indicators on main trunk below crown, and crown form; each tree species included in Van Pelt 2008 has a slightly different number and type of categories) and their rating scores, by individual category, are then combined by using a decision key to derive an overall score for the entire tree. A Scoring Key, which is specific to each tree species, is then used to identify an approximate age range for the tree.

This process is compatible with a Kahler project need to identify trees whose age is greater than or equal to 150 years because the Scoring Key for all three of the applicable Kahler tree species included in the Van Pelt (2008) guide – ponderosa pine, western larch, Douglas-fir – have an age-class break occurring at 150 years. If this was not true, then the Van Pelt (2008) guide would not be an acceptable alternative for identifying trees ≥ 150 years.

Although the Van Pelt (2008) guide does include an individual species treatment for grand fir (see pages 133-144 in Van Pelt 2008), it does not include a key involving individual categories of characteristics, or an overall Scoring Key to derive a final age estimate for grand fir trees. Therefore, any of the grand fir trees whose diameter exceeds 21" dbh, but for which there is uncertainty about whether their age exceeds 150 years, will be cored with an increment borer at breast height on the tree stem (4.5 feet) and their annual growth rings counted to derive an estimated age.

Age limits have been criticized as being more difficult to apply than diameter limits (Franklin and Johnson 2012), primarily because age criteria typically require each tree to be cored with an increment borer. Our experience with the Van Pelt (2008) guide for preliminary marking of treatment units for the Kahler project suggests it will work well. This assessment is based on extensive tree coring to compare Van Pelt (2008) age estimates with actual age measurements. The coring validation exercise involved four tree species in one large treatment unit in the Kahler project (fig. 23). [Even though Van Pelt (2008) does not provide a grand fir Scoring Key, grand fir trees were also cored during field validation efforts because this approach provides an overall sense of how many large grand firs are also young.]

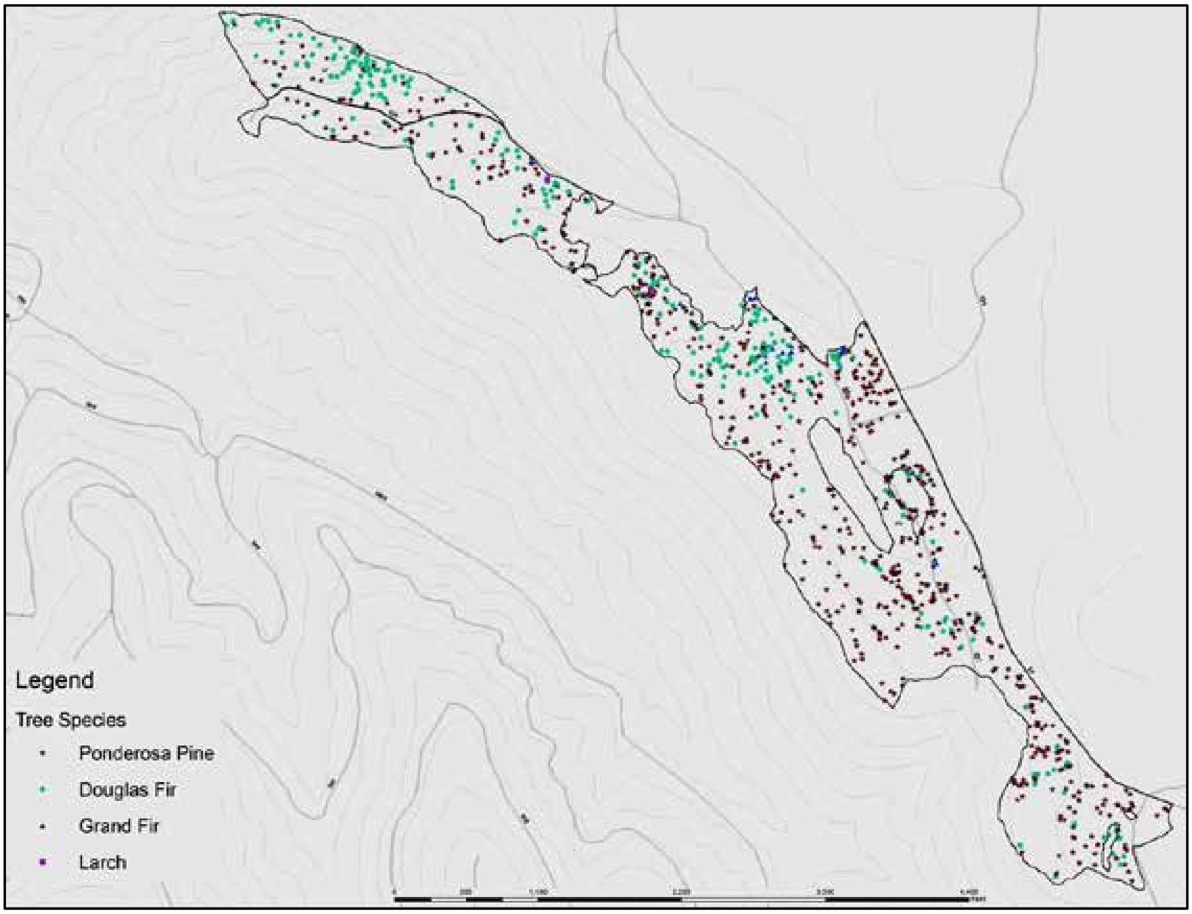


Figure 23 – Trees cored in unit 57a to determine tree age, at breast height, as a validation exercise for applying the Van Pelt (2008) guide. This map shows the location of 266 Douglas-firs, 19 grand firs, 2 western larches, and 650 ponderosa pines that were cored to determine their breast-height age during a validation exercise related to the Van Pelt (2008) old-tree field guide. Some of the trees shown on this map were included in a regression exercise to examine the relationship between dbh and tree age for a mix of grand firs and Douglas-firs in unit 57a (see bottom image in fig. 22).

Even though field validation (fig. 23) indicates that the Van Pelt (2008) guide acceptably identifies trees whose breast-height age is 150 years or greater, it is still important that "stakeholders and agency personnel must agree on some allowance for errors in age estimation" for this process to work in an operational (timber marking) setting (Franklin and Johnson 2012, p. 437).

As described in this section, the Kahler Dry Forest Restoration Project uses these specifications for old trees:

1. Definitions: Old trees are those whose age, at breast height (same point on tree where diameter is measured), is ≥ 150 years. Young trees are those whose breast-height age is < 150 years.
2. For all tree species except Douglas-fir and grand fir, trees ≥ 21" dbh will be retained regardless of their age, as required by scenario A of the Eastside Screens amendment to the FP, unless they qualify as a danger tree or pose an imminent safety hazard (Toupin et al. 2008).
3. During operational marking of treatment units, the Van Pelt (2008) guide will be used to estimate the age of ponderosa pine, western larch, and Douglas-fir trees (regardless of diameter) whose morphological traits, as related to bark, crown, and branching characteristics, suggest they may be old.

4. Old ponderosa pines, Douglas-firs, and western larches will be retained, unless their size is less than 10" dbh. [Old trees < 10" dbh tend to be long suppressed, and they seldom develop bark, crown, branching, and other morphological traits allowing them to be effectively rated by using the Van Pelt (2008) guide.]
5. The site-specific FP amendment described in this section authorizes some of the Douglas-fir and grand fir trees <150 years abh and ≥ 21" dbh to be removed, and it will implemented as follows:
    a. The Scoring Key in Van Pelt (2008) will be used to identify Douglas-fir trees that are large (≥ 21" dbh) but young (< 150 years abh).
    b. The Van Pelt (2008) guide does not include a Scoring Key for estimating grand fir tree age, so grand firs ≥ 21" dbh and appearing to be young will be cored with an increment borer to determine if their age is < 150 years abh.
    c. Many of the young but large (< 150 years abh, and ≥ 21" dbh) Douglas-fir and grand fir trees will be removed when located within a 2-dripline distance of a desirable tree.
    d. Wildlife considerations will be incorporated in the silvicultural prescriptions and marking guides to help determine which of the young but large (< 150 years abh, and ≥ 21" dbh) Douglas-fir and grand fir trees will be designated for retention or removal within a 2-dripline distance.

Defining and Determining Dripline Distance

Specifications regarding removal of some large but young Douglas-firs and grand firs are provided in the preceding section. Specifically, they stipulate that some large but young Douglas-firs and grand firs will be removed *when they occur within a 2-dripline distance of a desirable tree*.

This means that a decision to remove a large but young Douglas-fir or grand fir would be informed by the following decision protocol:
1) Is a large but young Douglas-fir or grand fir relatively near another tree (i.e., close enough, in general terms, to evaluate by using detailed criteria)?
2) If so, is the other tree a desirable tree?
3) If so, is the large but young Douglas-fir or grand fir within a 2-dripline distance of the desirable tree?
4) If so, does the large but young Douglas-fir or grand fir meet wildlife considerations for removal?

The remainder of this section addresses these three questions by: (1) describing desirable trees and referring the reader to a section of this forest vegetation specialist report in which desirable trees are defined; (2) establishing a definition for 'dripline'; (3) describing the source of the '2-dripline' specification; (4) providing a discussion about the rationale for using a dripline-based zone around desirable trees, and whether a 2-dripline distance is appropriate for dry-forest ecosystems of the Kahler planning area; and (5) explaining how a 2-dripline distance specification will be implemented for the Kahler project.

Desirable trees are defined in the context of the Purpose and Need statement for the Kahler project, and the definition includes a tree species hierarchy (preference). The species preference list, along with other aspects of defining a desirable tree, is provided on page 93 of this report. The tree-species preference list reflects a suite of life-history traits including seral status; insect, disease, drought, and fire resistance; and similar factors, and it considers these factors in the context of Kahler's dry-forest site conditions.

The primary rationale behind removing large but young Douglas-firs and grand firs is that old trees (those greater than 150 years abh) are desirable and valuable, and this is why old trees are listed first in the preference list on page 93. Large but young trees (those less than 150 years abh) growing in close proximity to old trees compete vigorously with them for soil moisture and nutrients – if large but young trees were not good competitors, they would not have been able to reach a large diameter in less than 150 years.

One objective of thinning activities in the Kahler proposed action is to help prevent development of what are termed 'focus trees,' which function as mountain pine beetle or western pine beetle attractant (Eckberg et al. 1994). It is believed that an otherwise normal tree becomes a focus tree by emitting high levels of volatile chemical compounds (Eckberg et al. 1994, Person 1931), such as ethanol (Kelsey 2001), and trees produce these chemical compounds in response to being under stress (Phillips and Croteau 1999).

Bark beetles respond to the chemical cues emitted by stressed trees and attack them, often resulting in tree mortality. Although low levels of ‘background’ tree mortality are both expected and desirable (functioning as a source of snags, for example), higher levels of mortality associated with dense, overstocked stands is uncharacteristic and undesirable, particularly when the trees being killed are old ponderosa pines occurring at reduced levels when compared with their historical abundance.

An important source of tree stress for old ponderosa pines, and an important contributor to development of focus trees and associated tree mortality caused by bark-beetle attack, is the presence of large but young Douglas-fir or grand fir trees in relatively close proximity to the old pines.

One method to characterize the competitive environment between trees growing in close proximity to each other is by using dripline distance. Dripline is defined in the glossary, and the dripline concept is illustrated in figure 24. In my judgment, based on more than 27 years of professional experience working with Blue Mountains forest ecosystems as a US Forest Service certified silviculturist, the dripline-distance concept effectively accounts for intertree competition relationships on dry-forest sites such as those in the Kahler planning area.

The primary reason that dripline distance effectively reflects intertree competition on dry-forest sites is that they are water-limited, and water-limited forests have mature trees whose crowns do not touch the crowns of neighboring mature trees (fig. 25). This means that root extent better reflects site occupancy for water-limited sites than crown extent – there can be wide distances between adjoining tree crowns on dry sites, and yet trees are fully utilizing the site because the soil is completely occupied by tree roots.
[For light or energy-limited forests like those of western Oregon, which are dominated by coastal Douglas-fir and western hemlock, proximity of tree crowns is an effective indicator of intertree competition, and dripline distance has less utility as a proxy for intertree competition there.]

As a tree gets larger, its crown also gets wider in diameter. It has been found that dripline distances can effectively approximate how much of the area around a tree is occupied by its roots. On a relative basis, large trees have large crowns, so the dripline distance around a large tree is greater than it is for a small tree. In other words, a 2-dripline distance around a large tree is greater than a 2-dripline distance around a small tree, and this difference is physiologically appropriate because research shows that roots extend farther around a large tree than they do around a small tree.
[As a tree crown expands in size, its leaf area increases. More leaf area represents greater evapotranspirational demand. More transpiring foliage requires more water and nutrients. Increased demand for water and nutrients results in a larger root system because roots collect water and nutrients for a tree.]

Why is a 2-dripline distance used for the Kahler project? A publication entitled “Restoration of Dry Forests in Eastern Oregon: A Field Guide” (Franklin et al. 2013) recommends that a 2-dripline distance be used in two places:

1. The ‘Apply Marking Guidelines’ section on page 120 states: “Retention of all older trees: in addition to retaining older trees we recommend removing fuels and competing vegetation from an area around the trees extending out about 2x the dripline of the old tree canopies; highly desirable structures within the dripline, such as an outstanding younger pine, can be marked for retention.”
2. The ‘Example Marking Guide Using the ICO Method’ section on page 149 states: “Around old ponderosa pine, remove young trees for 2 driplines – OK to keep 1-2 large/vigorous trees occasionally.”

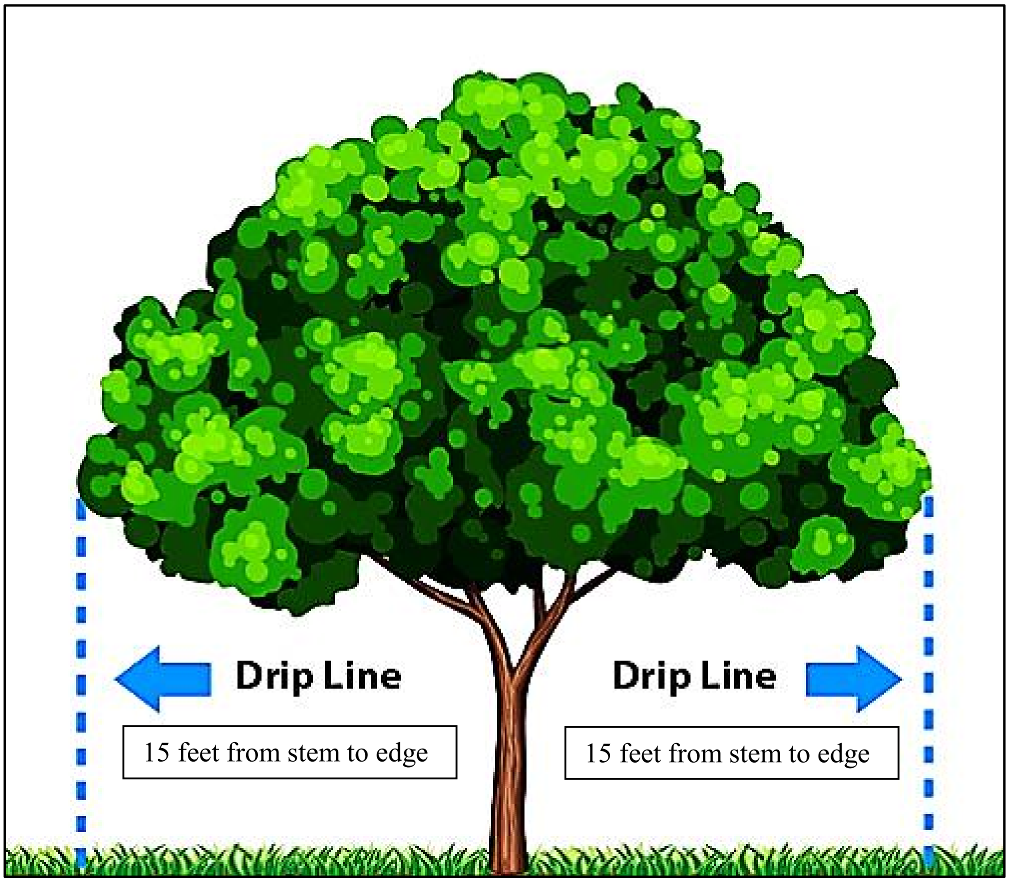


Figure 24 – Diagram illustrating the dripline concept. Dripline is defined in the glossary. For the Kahler project, dripline is assumed to represent a radial distance from the tree stem (outer edge of stem, not its center) to the outermost extent of the tree crown. Some of the large but young Douglas-firs and grand firs occurring within a 2-dripline distance of a desirable tree will be removed to address concerns related to intertree competition, bark-beetle risk, and ladder-fuel reduction.

An example – let's say that the total crown width (diameter) of this tree is 30 feet, and that the crown shape is symmetrical with the tree stem in the exact center. This means that the dripline distance, as it is defined in the glossary for the Kahler project, is 15 feet (half of the crown diameter). To implement a 2-dripline specification for this tree, a radial distance of 30 feet (two driplines) would be measured outward from the stem in any direction. This process results in the inner half of the 2-dripline zone (the first 15 feet from the stem) being underneath the existing crown; the outer half of the 2-dripline zone extends 15 feet beyond the crown and into an area occupied by the tree's roots. For the Kahler project, a large but young Douglas-fir or grand fir located anywhere in this 30-foot zone (15 feet from stem to outer crown edge, plus 15 feet beyond crown edge) could be considered for removal.

How does the Franklin et al. (2013) guide define dripline – is it radial distance from a tree stem to the outermost extent of the tree crown, or is it the distance from one edge of a crown to the opposite edge (the crown's diameter)? And why does the Franklin et al. (2013) guide recommend a 2-dripline distance instead of a 1-dripline, 3-dripline, or 5-dripline distance? Unfortunately, careful perusal of the Dry Forest Restoration Guide (Franklin et al. 2013) provides no additional elucidation about these questions.

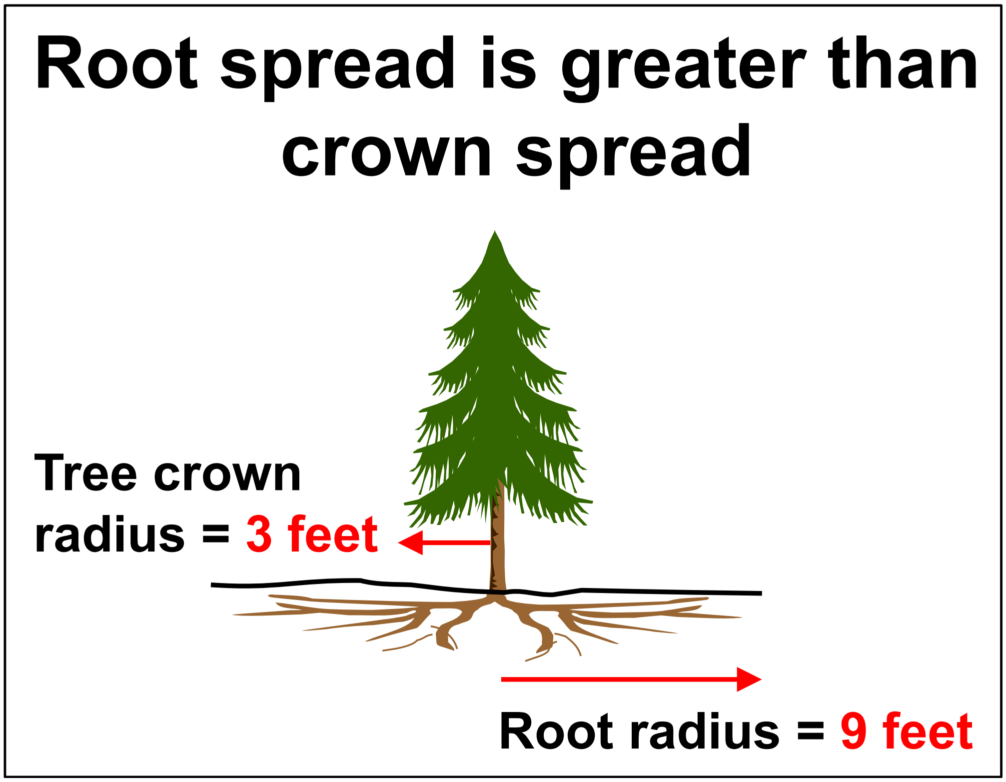


Figure 25 – Diagram illustrating crown spread versus root spread relationships. For conifer species in the Kahler area, root spread is always greater than crown spread. According to root-spread research studies cited throughout this section of the report, root spread is 1.2 to 5.4 times as wide as crown spread for ponderosa pine, 1.4 to 3.0 times as wide for Douglas-fir, and 2.5 to 3.2 times as wide for lodgepole pine. [Note: for the diagram presented in this figure, the crown-radius multiplier is 3.0 – crown radius (3 feet) times 3.0 equals root radius (9 feet).]

For dry-forest sites in the Kahler planning area, I consider a 2-dripline distance to be conservative. Because pine roots have a lateral distance of up to 5 times the radius of the crown (Berndt and Gibbons 1958, Curtis 1964, Greb and Black 1961, Hermann and Peterson 1969), a standard based on two driplines does not fully account for the fact that as sites become warmer and dryer, the distance between mature trees must increase to provide sufficient soil moisture and nutrients to ensure their survival and vigor. Mature ponderosa pines are the dominant and enduring biotic component on dry-forest sites; immature seedlings and saplings are not necessarily persistent, and they certainly do not require as much intertree spacing as mature trees. But the Kahler project is focused primarily on contributing to persistence of mature (old) trees, particularly old ponderosa pines, rather than sustaining seedling- and sapling-sized trees.

For the Kahler planning area, an intertree distance utilizing 2-3 driplines would be appropriate, in my professional judgment, for sites assigned to the Warm Dry plant association group (Powell et al. 2007). For the drier portion of the Dry Upland Forest PVG, including sites assigned to the Hot Dry plant association group (Powell et al. 2007), a distance based on 3-5 driplines would be physiologically appropriate. These recommendations are based on research studies examining root competition and crown spacing relationships for forest ecosystems (Aaltonen 1926, Bright 1914, Coomes and Grubb 2000, Fisher and Gosz 1986, McCune 1986, Pearson 1930, Stuart et al. 1989, Toumey 1926, Zon 1907).

For the Kahler project, a proposed FP amendment authorizing removal of some young but large Douglas-fir and grand fir trees will be implemented by only considering candidate trees occurring within a 2-dripline distance of a desirable tree, as recommended by the Restoration of Dry Forests in Eastern Oregon field guide (Franklin et al. 2013).

Rationale for Proposing Thinning Treatments in the OFSS Structural Stage

Scenario A of the Screens' wildlife standard allows timber harvest in LOS under two circumstances:

1. To transform some portion of an LOS component that is within or above HRV into an LOS component that is deficient (transforming MSLT into SSLT, for example).
   [MSLT is the Screens acronym for OFMS stage; SSLT is the Screens acronym for OFSS stage.]
2. To maintain or enhance existing conditions in LOS stands that are within or above HRV.

As described earlier in a "Consistency of Proposed Silvicultural Activities with Eastside Screens" section, the Kahler Dry Forest Restoration Project includes 400 acres of thinning treatment designed to transform MSLT, which is within HRV, into SSLT, which is below HRV (see tables 32 and 41). After treatment, however, MSLT will still be within HRV, and SSLT will still be below HRV, but SSLT will be closer to the lower limit of its historical range than before treatment. The wildlife standard permits this MSLT thinning activity to occur (see #1 above).

Alternative 2 also includes app. 1,090 acres of thinning in SSLT (970 acres for alt. 3) (table 52), an LOS stage below HRV. Intent of proposed SSLT thinning treatments is to maintain or enhance existing LOS conditions in the affected stands. According to Scenario A, thinning treatments are permissible for the MSLT stage because it is within HRV, but they are not permissible for SSLT because it is below HRV. Therefore, a Site-specific FP amendment is needed to authorize thinning activity in the SSLT stage, even though the silvicultural treatments are designed to maintain or enhance existing LOS conditions.

Thinning in SSLT stands will not change their LOS status – they are LOS before and after treatment. Therefore, thinnings meet the intent of Scenario A because there will be no change in LOS ("no net loss") after completing the treatments. The understory thinnings proposed for SSLT stands are designed to:

1. Improve tree vigor, and increase tree and stand resistance to western pine beetle and wildfire (fig. 16), thereby ensuring maintenance and persistence of the large-tree component into the future. Reestablishing an open, large-tree structure (fig. 17) will confer climate change resilience, and prescribed fire could then be applied safely to reintroduce a keystone ecosystem process – low-severity surface fire.
2. Contribute to species composition objectives for the Kahler project. Of the app. 1,090 acres of proposed SSLT treatment (alt. 2), app. 400 acres (37%) occurs in stands with a ponderosa pine cover type (PP is within HRV); the remaining app. 690 acres (63%) occurs in stands with a Douglas-fir cover type (DF is above HRV) (table 10). The ponderosa pine cover type treatments are designed to maintain ponderosa pine as the predominant tree species by preferentially removing grand fir or Douglas-fir (if some of the grand fir and Douglas-fir are not removed, then these stands will eventually transition from ponderosa pine cover type to Douglas-fir or grand fir cover type), whereas the Douglas-fir cover type treatments are designed to convert Douglas-fir type to ponderosa pine type, thereby reducing Douglas-fir acreage toward its HRV.
3. A secondary benefit of the species composition modifications described above for item #2 is that Douglas-fir tends to have high levels of infection by Douglas-fir dwarf mistletoe (fig. 26), a native parasite currently occurring at higher levels than would have been encountered historically when a surface-fire regime was functioning properly. Using silvicultural activities to modify stands with a Douglas-fir cover type would not only address a cover type objective by reducing the over-represented Douglas-fir type, but it could simultaneously reduce high levels of Douglas-fir dwarf mistletoe infection. High levels of dwarf mistletoe infection cause infected trees to not reach the size they normally would (such as 21" dbh or greater), and long, persistent, 'witches' brooms created by dwarf mistletoe act as ladder fuel (Schmitt and Spiegel 2012) by lifting surface fire up into the tree canopy, where it can then cause individual-tree or group torching, or perhaps initiate an active crown fire.

4. Contribute to stand density objectives for the Kahler project. The entire 1,090 acres of proposed SSLT treatment occurs in stands with high density. High stand density is substantially above HRV (table 14), and these stands are highly susceptible to crown fire and other uncharacteristic disturbance effects. Proposed silvicultural treatments are designed to reduce high stand density to either the moderate or low stand density class, depending on resource objectives. In areas with wildlife habitat connectivity objectives, SSLT thinnings will transform high stand density to moderate stand density; in areas without wildlife connectivity objectives, SSLT thinnings will transform high stand density to the low stand density class.
5. Protect large trees by removing 'ladder' fuel from their proximity. Ladder fuel consists of small trees or large shrubs providing vertical continuity from surface fuels to canopy (crown) fuels (Stephens et al. 2012) (see glossary). When we were encouraged by the Regional Forester (Goodman 2003) and the Umatilla NF Forest Supervisor (Blackwood 2003) to consider site-specific Forest Plan amendments for Scenario A situations, treatment of ladder fuels to protect older trees was provided specifically as one of five examples for when this course of action might be appropriate (ladder-fuel treatment was the fourth example in both the Goodman (2003) and Blackwood (2003) memorandums).

A site-specific FP amendment to authorize removing large but young grand firs and Douglas-firs (trees ≥ 21" dbh and < 150 years abh), and to complete thinning activities in the OFSS/SSLT forest structural stage, are both well-aligned with species composition, stand density, insect susceptibility, climate change adaptation, and ladder fuel objectives established for the Kahler Dry Forest Restoration Project.

The Pacific Northwest Regional Forester encouraged us "to consider site-specific Forest Plan amendments where this will better meet LOS objectives" (Goodman 2003, p. 1). The proposed Kahler FP amendment is fully compatible with her 'encouragement' to consider site-specific FP amendments for silvicultural activities that will better meet LOS objectives.

The Umatilla NF Forest Supervisor encouraged us to consider removal of large trees of undesirable species or condition under certain circumstances (Blackwood 2003, p. 4):

> "Large trees with insect or disease issues limiting their capability to contribute to an area's desired future condition, or late-seral species occurring in proportions exceeding HRV with respect to species composition, are two examples of situations where minor numbers of large trees may be designated for removal within the context of an overall thinning prescription."

Figure 26 – Example of dwarf mistletoe parasitism affecting Douglas-fir (photograph acquired in the Kahler planning area; reproduced from Schmitt and Spiegel 2012). Douglas-fir dwarf mistletoe is considered to be the insect or disease agent of most concern in terms of long-term resilience and sustainability of Douglas-fir trees in dry-forest ecosystems of the Kahler planning area (Schmitt 1997; Schmitt and Spiegel 2010, 2012). Also note that dwarf mistletoe was judged to be one of two factors, with the other being root disease, that predisposes Douglas-fir trees (and stands) to attack by Douglas-fir beetles (Scott 1996).

Most of the Douglas-firs in this image have dense, bunched branches called 'witches' brooms' caused by Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*). Dwarf mistletoe has important ecosystem benefits – studies found that witches' brooms can function as crucial wildlife structure for several avian and mammal species (Bull and Heater 2000, Hedwall and Mathiasen 2006, Mlot 1991). Studies also found that dwarf mistletoe was generally not being used as food – its berries are small and hard – but the witches' brooms it causes in the host trees provide bird and mammal nesting and roosting sites, and served as habitat for butterflies, moths, and other insects that birds feed on.

Since birds are important predators of defoliating insects such as western spruce budworm and Douglas-fir tussock moth (Garton 1987), both of which have been quite active historically in the Kahler planning area (see fig. 7), it may not be prudent to remove all of the mistletoe-infected trees in dry mixed-conifer forests with high susceptibility to defoliating insects (Parks et al. 1999).

So, how many of the trees infected with Douglas-fir dwarf mistletoe should be retained, and how many should be removed? Some guidelines for these decisions at the individual-stand level are provided by Schmitt (1997). When considering an appropriate representation of dwarf-mistletoe-infected stands at a landscape scale, Blue Mountains land managers could consult the historical range of variation information contained in Schmitt and Powell (2012) (this source provides HRV information specifically for Douglas-fir dwarf mistletoe, and the ranges of high, moderate, and low susceptibility vary by potential vegetation group; e.g., the ranges vary for the Dry Upland Forest, Moist Upland Forest, and Cold Upland Forest PVGs).

"If incidental removal of large trees occurs, however, it is assumed that the post-treatment stand will contain a large-tree component sufficient to qualify it as LOS (in other words, the stand was LOS before treatment and it is still LOS after treatment), *and that a site-specific Forest Plan* *amendment will be processed to disclose that some portion of the large trees are proposed for removal, and to develop the rationale for their removal*."

The proposed Kahler FP amendment is fully compatible with the Blackwood (2003) guidance.

Context for the Proposed Forest Plan (Eastside Screens) Amendment

This section summarizes certain contextual aspects of a proposed, project-scale revision to the Eastside Screens amendment of the Land and Resource Management Plan for the Umatilla National Forest.

Geographical scope. The scope of the Eastside Screens is 'timber sales,' so the geographical scope of a site-specific revision to the Eastside Screens amendment of the Land and Resource Management Plan for the Umatilla National Forest (the Screens are amendment #11 to the Umatilla FP) is timber sale activity (treatment) units located within the Kahler planning area. The project-scale Screens amendment pertains to app. 12,220 acres of proposed silvicultural activity (alternative 2), or app. 11,540 acres of proposed silvicultural activity, depending on which of the action alternatives is selected for implementation.

Temporal scope. The temporal scope of a project-scale revision to the Eastside Screens amendment of the Land and Resource Management Plan for the Umatilla National Forest (the Screens are amendment #11 to the Umatilla FP) is the same time period covered by a Record of Decision for the final environmental impact statement for the Kahler Dry Forest Restoration Project.

Other project-scale Screens amendments for the Umatilla NF. A project-scale revision of the Eastside Screens amendment to the Umatilla FP, if adopted as proposed for the Kahler Dry Forest Restoration Project, would be the fifth project-scale Screens amendment for the Umatilla NF. The Screens were initially implemented in August 1993, and it is my professional judgment that dozens of timber sales (probably more than 50 but less than 100 sales) on the Umatilla NF have been required to comply with the Screens during the 21-year period since their adoption.

During this 21-year time period, only four site-specific, project-scale amendments to the Eastside Screens have been approved for the Umatilla NF (table 53). All four of them involved revision of the wildlife standard to allow trees ≥ 21" dbh to be removed (harvested).

Table 53: Project-scale amendments of the Eastside Screens for the Umatilla NF

Approval Date	Timber Sale Project Name	Comments About Amendment's Scope
2/14/1996	Indianberry Salvage and Rehabilitation Project	Amendment exempts units 29 and 36 only from meeting the 21" dbh removal limit for live trees in late-old structure stands.
5/29/1996	Tucannon Timber Sale	Amendment authorizes "some lives trees ≥ 21 inches DBH in the warm/dry biophysical group" to be removed.
6/11/2007	School Fire Salvage Recovery Project	Amendment revises the Screens wildlife standard to define live and dead trees, thereby allowing removal of 'dying,' fire-damaged trees ≥ 21" dbh.
7/12/2010	Wildcat II Fuels Reduction and Vegetation Management Project	Amendment authorizes trees ≥ 21" dbh to be removed from two aspen stands occupying 12 acres within a 25,450-acre planning area.

Sources/Notes: Information in this table was derived from a website summarizing Forest Plan amendments for the Umatilla NF (http://www.fs.usda.gov/detailfull/umatilla/landmanagement/planning/?cid=stelprdb5209324&width=full). Note that none of these Eastside Screens amendments have any geographical or temporal relationship to the proposed Screens amendment for the Kahler project – they do not overlap with Kahler in either space or time.

Uniqueness of the proposed Kahler Screens amendment. The geographical unit to which the ecosystem and wildlife standards apply is a watershed, not a national forest. In other words, when the Forest Service decided to establish ecosystem and wildlife standards related to timber sales by issuing the Eastside Screens (USDA Forest Service 1994, 1995), it did so by directing that the standards would be applied to a watershed as the appropriate geographical unit.

Detailed information about Eastside Screens assumptions is provided in the Environmental Assessment (EA) for Regional Forester's Forest Plan Amendment 1 (USDA Forest Service 1994). The 1994 EA states, on page III-2, "For this screening, watersheds should average about 25,000 acres (15,000-35,000) to ensure that vegetation pattern relations are adequately assessed. Watersheds should be larger than the average contiguous area extent of the dominant disturbance regime (e.g., fire); ideally at least two to three times that area."

The analyses presented in this Forest Vegetation specialist report pertain to five contiguous and adjoining 'watersheds' (subwatersheds in this specific instance): Alder Creek (170702040108), Lower Kahler Creek (170702040104), Upper Kahler Creek (170702040103), Haystack Creek (170702040105), and Bologna Canyon (170702040101). Some might argue that forest conditions for which this Screens amendment is proposed occur elsewhere on the Umatilla NF and thus are not 'site-specific.' This argument is not persuasive for the Kahler Dry Forest Restoration Project because:

- Dozens of upland-forest projects have occurred on the Umatilla NF since the Screens were adopted in August 1993, and yet the Screens have only been amended four times (table 53). In my judgment, this outcome means that no more than 10% of the timber sales have included a Screens amendment. If amending the Screens is viewed as a typical and customary practice for the Umatilla NF, then why have less than 10% of Umatilla NF timber sales resulted in Screens amendments?
- The Kahler project analyzed vegetation conditions for five contiguous subwatersheds, and the proposed Screens amendment is responsive to results from these specific analyses. Since the five subwatersheds encompass a large enough area to effectively assess cumulative effects for upland-forest activities, areas beyond the five subwatersheds were not analyzed or assessed. Therefore, the forest vegetation analyses provide no basis for evaluating whether conditions outside the Kahler planning area are similar to those within the planning area. Absent such an analysis, it is speculation to assume that conditions within Kahler are not 'unique' (however it would be defined), or not site-specific.
- Even though the Eastside Screens have only been amended four times since their incorporation into the Forest Plan in 1994, suggesting that Screens amendments are uncommon for the Umatilla NF, the proposed Kahler amendment differs substantially from the previous four amendments because none of them used a 150-year age requirement, in conjunction with the 21" dbh limitation, as is proposed for the Kahler project.
- I contend that Kahler's proposed Screens amendment involving removal of some young but large (< 150 years abh, and ≥ 21" dbh) grand firs and Douglas-firs located within a 2-dripline distance of a desirable tree is an adequate and appropriate reflection of project-scale, site-specific conditions because it is very selective in how it would be implemented:
  (a) it affects only two tree species (a total of five species are common in proposed timber sale activity units – see page 93);
  (b) it affects grand firs and Douglas-firs ≥ 21" dbh only when they are less than 150 years abh (grand firs and Douglas-firs > 150 years abh are not affected by the amendment); and
  (c) it affects young but large (< 150 years abh and ≥ 21" dbh) grand firs and Douglas-firs only when they occur within a 2-dripline distance of a desirable tree (young but large grand firs and Douglas-firs are not affected by the amendment when located more than a 2-dripline distance away from a desirable tree).

The Kahler planning area totals approximately 32,840 acres, and it consists of five adjoining and contiguous subwatersheds (HUC6s in the hydrologic framework). Most of the Kahler planning area can be assigned to fire regimes I and II (Marshall 2014), and the recommended analysis area for evaluating fire and fuels relationships for these particular fire regimes is a subwatershed (HUC6) (Barrett et al. 2010). When considering these facts together, the Kahler planning area meets or exceeds the 1994 Screens EA direction because:

- Planning-area size (app. 32,840 acres) is near the upper end of the recommended size range (15,000-35,000 acres) from the 1994 Eastside Screens EA.
- The dominant disturbance regime for Kahler (surface fire), as reflected in its prevailing fire regimes (fire regimes I and II), is evaluated for five subwatersheds (HUC6s), not just for one subwatershed as recommended by Barrett et al. (2010).
- So, this means that direction from the 1994 Screens EA to use a geographical context such that "watersheds should be larger than the average contiguous area extent of the dominant disturbance regime" has been exceeded by a substantial amount because five subwatersheds were used to establish a Kahler planning area, even though one subwatershed would have provided sufficient geographical context for the dominant disturbance regime (fire regimes I and II).

The Kahler planning area of app. 32,840 acres is also used as a cumulative effects analysis area for forest vegetation. Approximately 26,980 acres of the app. 32,840 total acres are used for forest vegetation HRV analyses; the balance of the planning area is nonforest, woodland, or biophysical environments (such as moist upland forest) lacking sufficient acreage to include them in an HRV analysis.

Direct effects are assessed for just the area affected by proposed implementation of management activities (app. 12,220 acres for alt. 1; app. 11,540 acres for alt. 2), but the cumulative effects analysis considers direct, indirect, and present (ongoing) effects of project implementation across the entire app. 32,840-acre area. I see no ecological or environmental reason for why the cumulative-effects (c-e) analysis for species composition, forest structure, and stand density would need to include an area larger than the Kahler planning area, and I don't believe the Screens requires a larger c-e analysis area either.

Using the Kahler project planning area as a cumulative-effects analysis area agrees with prevailing environmental analysis guidance (including CEQ 1997) that "the spatial scale of the assessment should be defined by the spatial scale of the processes that control the resources of concern" (MacDonald 2000). Once again, using five subwatersheds to establish a planning area provides appropriate spatial context (scale) for both the disturbance regimes and the resources of concern (e.g., forest vegetation composition, structure, and density).

Degree to Which the Purpose and Need for Action is Met

As described throughout this specialist report, forest vegetation analyses rely on an analytical technique referred to as the historical range of variation (HRV). [A subsection in the Methodology section called "Historical Range of Variation Analytical Technique," page 17, describes HRV in more detail. Additional HRV background is also provided in Powell (2014b), a white paper incorporated by reference for this forest vegetation analysis.]

Table 54 summarizes HRV results, by alternative, for indicators or measures relating to species composition, forest structure, and stand density. Using HRV to analyze trends in composition, structure, and density directly supports the Kahler project's purpose and need: "restore and promote open stands of old forest dominated by ponderosa pine, thereby moving the area toward its historical range in structure, density, and species composition."

Table 54 provides trend information for species composition, forest structure, and stand density by presenting HRV results for three alternatives, and for two time periods (2015 and 2065).

Inspection of the HRV results displayed in table 54 suggests the following conclusions:

1. The No Action alternative (alt. 1) tends to depart more from the historical range of variation, for most indicators or measures, than for either of the action alternatives. An exception is stand density – all three alternatives have comparable numbers of indicators that depart from HRV for stand density (but this occurs because we could not assume that recurring maintenance treatments – thinning and prescribed fire – would be implemented every 10-20 years to maintain stand density within its range).
2. The action alternatives (alts. 2 and 3) are more effective at moving species composition indicators within HRV than is demonstrated by the No Action alternative (alt. 1).
3. Many of the trends presented in table 54 demonstrate the value and importance of maintenance – silvicultural treatments proposed for the Kahler Dry Forest Restoration Project successfully move some of the indicators within their range of variation initially (2015), but a lack of future maintenance treatments allows some of them to move outside HRV by 2065. The Douglas-fir indicator for species composition clearly shows this trend, along with all three of the indicators for stand density.

I recognize that frequent application of prescribed fire (on a cycle of 10-20 years) would prevent forest vegetation from transitioning back to a condition outside of HRV. For this forest vegetation analysis, however, it was NOT explicitly assumed that prescribed fire will occur on a 10-20 year cycle because of uncertainty about burn windows, smoke management, funding levels, and other factors.

In fact, no future application of prescribed fire or maintenance thinning was assumed for this analysis because it was deemed to be speculative (e.g., we cannot guarantee that future treatments will occur, or that they will occur on a specific schedule, so they were not included in the effects analysis). Had prescribed fire or noncommercial thinning been assumed to occur on a 10- to 20-year cycle into the future, the 2065 HRV results would undoubtedly have differed from what is presented in table 54.

If this analysis had been able to assume that future thinnings and prescribed fires would occur regularly (e.g., on a cycle of 10 to 20 years between treatments), then a large body of research findings (such as Martinson and Omi 2013) suggests that the Kahler planning area could be maintained in a condition supporting future wildfires of low severity, even when considering projected climate change effects (fig. 16).

The opportunity to create and sustain future conditions supporting low-severity fire is extremely beneficial because the Kahler planning area occurs in an area with high levels of recent wildfire activity (fig. 27), and future wildfire levels are projected to be much higher than recent levels (fig. 16).

Table 54: Summary comparison of how alternatives address the Purpose and Need

Purpose & Need	Indicator or Measure	Alternative 1		Alternative 2		Alternative 3	
		2015	2065	2015	2065	2015	2065
Move species composition toward its historical range of variation (HRV)	Ponderosa pine is between 50% and 80% of the Dry Upland Forest (UF) biophysical environment (BE) after project implementation in 2015	64%	27%	79%	54%	78%	53%
	Douglas-fir is between 5% and 20% of the Dry UF BE after project implementation in 2015	29%	58%	16%	37%	17%	38%
	Grand fir is between 1% and 10% of the Dry UF BE after project implementation in 2015	5%	12%	3%	7%	3%	7%
Move forest structure toward its HRV	Stand initiation is between 15% and 25% of the Dry UF BE after project implementation in 2015	19%	12%	19%	12%	19%	12%
	Stem exclusion is between 10% and 20% of the Dry UF BE after project implementation in 2015	35%	16%	48%	14%	47%	14%
	Understory reinitiation is between 5% and 10% of the Dry UF BE after project implementation in 2015	32%	45%	19%	18%	20%	20%
	Old forest single stratum is between 40% and 60% of the Dry UF BE after project implementation in 2015	6%	0%	7%	39%	7%	37%
	Old forest multi-strata is between 5% and 15% of the Dry UF biophysical environment after project implementation in 2015	9%	27%	7%	16%	7%	17%
Move stand density toward its HRV	Low stand density is between 40% and 85% of the Dry UF BE after project implementation in 2015	38%	15%	75%	16%	73%	16%
	Moderate stand density is between 15% and 30% of the Dry UF BE after project implementation in 2015	17%	6%	9%	48%	9%	45%
	High stand density is between 5% and 15% of the Dry UF BE after project implementation in 2015	45%	79%	16%	37%	18%	39%

Sources/Notes: the historical range percentages provided for each indicator/measure are taken from Martin (2010); they pertain to the Dry Upland Forest PVG only, which comprises approximately 26,980 acres of the forest vegetation affected environment. Data sources are as follows:
Alternative 1 (Alt 1) – existing (2012) and 2065 conditions in planning area for Dry UF BE (see tables 10, 12, and 14 for 2012 conditions, and tables 22, 25, and 28 for 2065 conditions).
Alternative 2 (Alt 2) – post-implementation conditions for Dry UF BE in 2015 and 2065 (see tables 31, 34, and 37).
Alternative 3 (Alt 3) – post-implementation conditions for Dry UF BE in 2015 and 2065 (see tables 40, 43, and 46).
Note: Gray cells show percentages that exceed the range of variation by 3% or more (above or below).

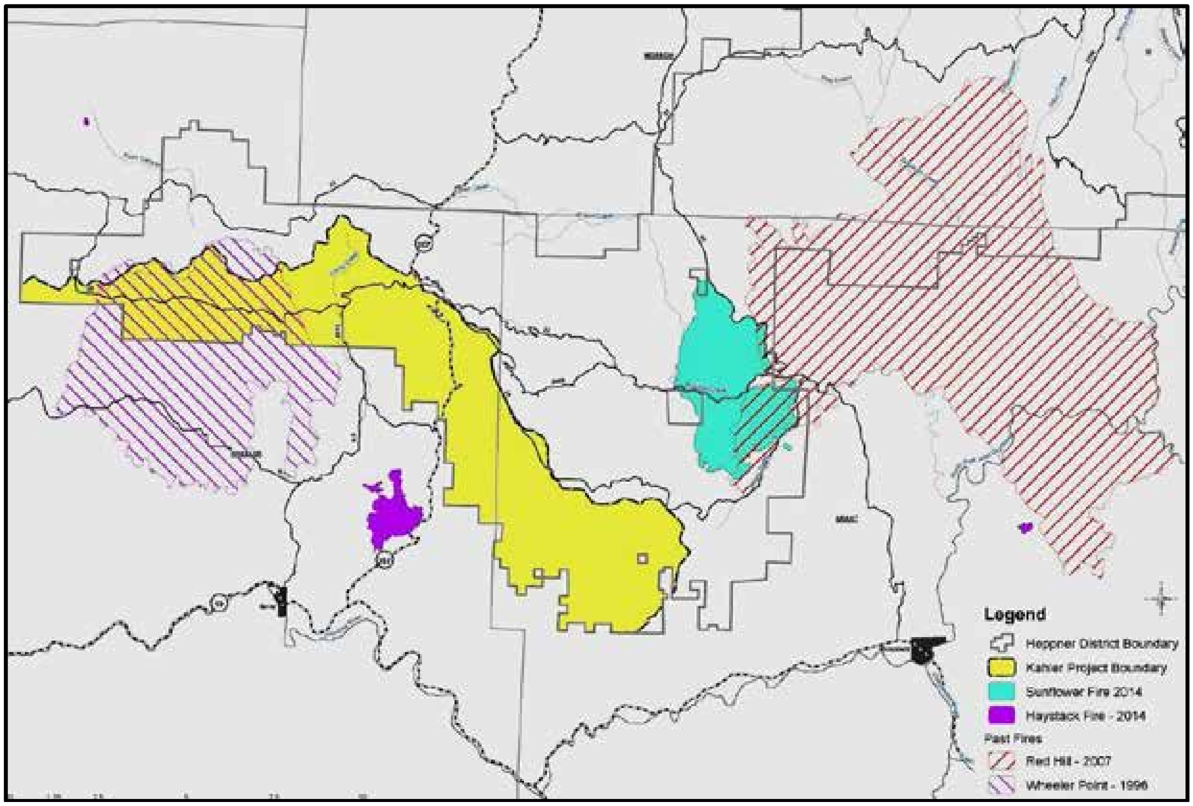


Figure 27 – Recent wildfire activity in the vicinity of the Kahler planning area (source: GIS data available from the digital fire atlas for the Umatilla National Forest). This map shows that the Kahler planning area occurs in a portion of the western Blue Mountains with an active recent fire history. Projections suggest that fire activity in this area could increase substantially in the future in response to climate change (fig. 16). The silvicultural activities proposed for implementation by the Kahler Dry Forest Restoration Project have been designed with both climate change and fire risk in mind – thinnings, prescribed fire, and other treatments are intended to manage canopy fuels by disrupting canopy continuity (which reduces crown-fire spread rates), reducing ladder fuels (which lessens the potential for surface fire to transition to crown fire), and maintaining surface fuels at reasonable and characteristic levels for the warm dry biophysical environments found in the Kahler planning area.

Appendix 1: Planning Unit Treatments by Alternative

Table 55: Summary of forest vegetation treatment information by cutting unit (notes at end of table provide additional detail about this summary)

Unit	MA	Alt 2 Acres	Alt 3 Acres	Harvest System	Alt 2 Forest Veg Treatment	Alt 3 Forest Veg Treatment	Alt 2 Fuels Treatments	Class 4 Tmt Acres	Pre-Treat CT	Post-Treat CT	Pre-Treat SS	Post-Treat SS	Pre-Treat DC	Post-Treat DC
1	E1	83	83	Ground	VDT/ICO	VDT/ICO	MST/JP	5.7	PP	PP	SE	SE	H	L
10	E1	14	14	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	SE	SE	H	L
100	C3	17	17	NCT	NCT	NCT	UB	0.0	PP	PP	SE	SE	L	L
10a	E1	18	0	Ground	VDT/ICO	——	MST/UB	0.1	GF	PP	OFMS	OFMS	H	L
10b	E1	24	0	Ground	VDT/ICO	——	MP/BP/UB	0.9	GF	PP	OFMS	OFMS	H	L
11	E1	128	128	Ground	VDT/ICO	VDT/ICO	MST/UB	6.2	DF	PP	SE	SE	H	L
11b	E1	120	120	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	9.0	PP	PP	UR	UR	H	L
12	E1	59	59	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	1.6	DF	PP	UR	SE	H	L
12a	E1	74	74	Ground	VDT/ICO	NCT-JUOC	MP/BP/UB	0.4	GF	DF	OFMS	OFMS	H	L
13	E1	42	42	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	0.3	DF	PP	SE	SE	H	L
13a	E1	15	15	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	SE	SE	M	L
13b	E1	36	36	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	0.9	DF	PP	SE	SE	H	L
14	E1	258	258	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	11.3	DF	PP	UR	SE	H	L
15	E1	87	87	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	2.8	DF	DF	UR	UR	H	L
16	E1	100	100	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	2.0	PP	PP	SE	SE	H	L
17	E1	245	245	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	22.2	PP	PP	SE	SE	M	L
18	E1	150	150	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	0.8	DF	PP	UR	SE	H	L
18a	E1	74	74	Ground	VDT/ICO	VDT/ICO	MST/UB	5.1	GF	PP	SE	SE	H	L
18b	E1	54	54	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	1.6	DF	PP	OFSS	OFSS	H	L
19	E1	250	250	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	2.7	PP	PP	UR	UR	H	L
2	E1	112	38	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	8.7	DF	PP	UR	SE	H	L
20	E1	31	31	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	4.7	PP	PP	UR	SE	H	L
200	E1	38	38	NCT	S-S NCT	S-S NCT	UB		PP	PP	UR	UR	H	L
201	C3	129	129	Ground	S-S	S-S	JP/UB		PP	PP	SE	SE	M	L
202	E1	131	131	Ground	S-S	S-S	JP/UB	4.2	PP	PP	SE	SE	L	L
205	C3	98	98	Ground	S-S	S-S	JP/UB	1.8	PP	PP	UR	SE	L	L
205a	C3	107	107	NCT	NCT	NCT	UB		PP	PP	UR	SE	M	L
205b	C3	391	391	Ground	S-S	S-S	JP/UB	5.6	PP	PP	UR	SE	H	L
207	C3	319	319	Ground	S-S	S-S	JP/UB	41.9	WJ	PP	SE	SE	L	L

Unit	MA	Alt 2 Acres	Alt 3 Acres	Harvest System	Alt 2 Forest Veg Treatment	Alt 3 Forest Veg Treatment	Alt 2 Fuels Treatments	Class 4 Tmt Acres	Pre-Treat CT	Post-Treat CT	Pre-Treat SS	Post-Treat SS	Pre-Treat DC	Post-Treat DC
208	C3	141	141	Ground	S-S	S-S	JP/UB	0.2	PP	PP	SE	SE	L	L
209	E1	25	25	Ground	S-S	S-S	JP/UB		PP	PP	UR	SE	L	L
20a	E1	16	16	Ground	VDT/ICO	VDT/ICO	MST/UB	1.9	DF	PP	SE	SE	H	L
21	E1	50	50	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	2.6	DF	PP	UR	SE	H	L
210	E1	60	60	Ground	S-S	S-S	JP/UB	0.2	PP	PP	UR	SE	L	L
212	C3	161	161	Ground	S-S	S-S	JP/UB	13.4	PP	PP	UR	SE	M	L
21a	E1	112	112	Ground	VDT/ICO	VDT/ICO	MST/UB	6.1	DF	PP	OFMS	OFMS	H	L
21b	E1	119	82	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	0.3	DF	PP	SE	SE	H	L
21c	E1	14	14	Ground	VDT/ICO	VDT/ICO	MST/UB		PP	PP	UR	UR	H	L
21d	E1	11	11	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	OFSS	OFSS	H	L
21e	E1	32	32	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	SE	SE	M	L
22	C3	331	331	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	32.2	PP	PP	UR	SE	M	L
23	E1	123	123	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	3.5	PP	PP	UR	SE	H	L
23a	E1	53	53	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	4.3	DF	PP	UR	UR	H	L
23b	E1	46	0	Ground	VDT/ICO	——	MP/BP/UB	3.9	DF	PP	UR	SE	H	L
23c	E1	79	79	Ground	VDT/ICO	NCT-JUOC	MP/BP/UB	0.0	DF	PP	UR	SE	H	L
24	E1	71	71	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	2.5	PP	PP	SE	SE	M	L
24a	E1	50	50	Ground	VDT/ICO	VDT/ICO	MST/UB		DF	PP	SE	SE	M	L
24b	E1	24	24	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	SE	SE	H	L
25	E1	25	25	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	UR	SE	H	L
26	E1	116	116	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	SE	SE	H	L
26a	E1	48	48	Ground	VDT/ICO	VDT/ICO	MST/UB		PP	PP	SE	SE	H	L
27	C3	209	209	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	12.7	PP	PP	UR	SE	H	L
27a	C3	27	27	Ground	VDT/ICO	VDT/ICO	MST/UB	0.5	GF	DF	OFMS	OFSS	H	L
27b	C3	61	61	Ground	VDT/ICO	VDT/ICO	MST/UB		DF	PP	OFMS	OFMS	H	L
27c	C3	17	17	Ground	VDT/ICO	VDT/ICO	MST/UB	5.9	PP	PP	UR	SE	H	L
28	E1	34	34	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB		DF	PP	SE	SE	H	L
28a	E1	190	190	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	0.0	PP	PP	UR	SE	H	L
29	C3	68	68	Ground	VDT/ICO	VDT/ICO	MST/UB	0.4	DF	PP	UR	SE	H	L
3	E1	49	49	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	OFSS	OFSS	H	L
30	E1	17	17	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	UR	SE	H	L
30a	E1	29	0	Ground	VDT/ICO	——	MP/BP/UB	0.0	PP	PP	UR	UR	H	L
31	C3	96	96	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	15.9	PP	PP	OFMS	OFSS	H	L

Unit	MA	Alt 2 Acres	Alt 3 Acres	Harvest System	Alt 2 Forest Veg Treatment	Alt 3 Forest Veg Treatment	Alt 2 Fuels Treatments	Class 4 Tmt Acres	Pre-Treat CT	Post-Treat CT	Pre-Treat SS	Post-Treat SS	Pre-Treat DC	Post-Treat DC
31a	C3	47	47	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	3.2	DF	PP	UR	SE	M	L
31b	C3	60	60	Ground	VDT/ICO	VDT/ICO	MST/UB	6.6	PP	PP	UR	UR	H	L
32	C3	51	51	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	18.5	PP	PP	OFMS	OFMS	H	L
33	C3	16	16	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	0.8	DF	PP	UR	SE	H	L
34	C3	13	13	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB		GF	DF	OFMS	OFMS	H	L
35	C3	69	69	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	19.6	DF	PP	OFSS	OFSS	H	L
36	C3	26	26	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	0.2	PP	PP	OFSS	OFSS	H	L
36a	A4	24	24	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	0.0	GF	GF	OFMS	OFMS	H	L
36b	C3	29	29	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	0.3	GF	GF	OFMS	OFMS	H	L
37	A4	60	60	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	10.2	DF	PP	OFSS	OFSS	H	L
38	C3	20	20	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	0.2	DF	PP	SE	SE	H	L
39	C3	17	17	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	0.0	DF	PP	OFSS	OFSS	H	L
3a	E1	78	78	Ground	VDT/ICO	VDT/ICO	MST/JP	0.4	PP	PP	UR	SE	H	L
3b	E1	63	63	Ground	VDT/ICO	VDT/ICO	MP/BP	0.5	PP	PP	UR	SE	H	L
4	E1	20	20	Ground	VDT/ICO	VDT/ICO	MP/BP		DF	DF	OFSS	OFSS	H	L
40	A4	24	24	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	7.6	PP	PP	SE	SE	M	L
40a	A4	15	15	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	SE	SE	M	L
40b	E1	18	18	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	1.9	PP	PP	SE	SE	M	L
40c	E1	47	47	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	13.8	DF	PP	UR	SE	H	L
41	A4	75	75	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	3.6	DF	PP	SE	SE	M	L
41a	E1	59	59	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	10.3	DF	PP	SE	SE	H	L
42	E1	25	25	Skyline	VDT/ICO	VDT/ICO	MP/BP/JP/UB		DF	PP	SE	SE	H	L
42a	A4	22	22	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	SE	SE	H	L
42b	E1	46	46	Ground	VDT/ICO	VDT/ICO	MST/UB		DF	PP	UR	SE	H	L
42c	E1	9	9	Skyline	VDT/ICO	VDT/ICO	MP/BP/JP/UB		DF	PP	UR	SE	H	L
42d	E1	13	13	Ground	VDT/ICO	VDT/ICO	MST/UB		DF	PP	UR	SE	H	L
42e	E1	9	9	Skyline	VDT/ICO	VDT/ICO	MP/BP/JP/UB		DF	PP	UR	SE	H	L
43(a)	A4	32	32	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	9.5	PP	PP	SE	SE	M	L
43(b)	A4	42	42	Ground	S-S	S-S	JP/UB	2.4	PP	PP	SE	SE	M	L
43a	E1	424	424	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	33.6	PP	PP	UR	UR	H	L
44	E1	14	14	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	6.4	PP	PP	SE	SE	M	L
45	E1	37	37	Skyline/Ground	VDT/ICO	VDT/ICO	MP/BP/UB	0.0	DF	PP	SE	SE	H	L
46	E1	69	69	Skyline/Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	OFSS	OFSS	H	L

Unit	MA	Alt 2 Acres	Alt 3 Acres	Harvest System	Alt 2 Forest Veg Treatment	Alt 3 Forest Veg Treatment	Alt 2 Fuels Treatments	Class 4 Tmt Acres	Pre-Treat CT	Post-Treat CT	Pre-Treat SS	Post-Treat SS	Pre-Treat DC	Post-Treat DC
47	E1	7	7	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	0.8	PP	PP	UR	SE	L	L
48	E1	10	10	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	0.2	PP	PP	SE	SE	M	L
49	E1	31	31	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB		PP	PP	SE	SE	M	L
49a	E1	16	16	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	UR	SE	M	L
49b	E1	20	20	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	0.4	DF	PP	OFSS	OFSS	H	L
4b	E1	103	103	Ground	VDT/ICO	VDT/ICO	MST/JP		DF	DF	OFSS	OFSS	H	L
5	E1	32	0	Ground	VDT/ICO	——	MP/BP/UB	5.5	PP	PP	SE	SE	M	L
50	E1	26	26	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB		DF	PP	SE	SE	H	L
51	E1	16	16	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		GF	PP	OFMS	OFSS	H	L
51a	E1	24	24	Skyline/Ground	VDT/ICO	VDT/ICO	MP/BP/UB		GF	PP	OFMS	OFSS	H	L
52	E1	58	58	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	OFMS	OFMS	H	L
53	E1	172	172	Skyline/Ground	VDT/ICO	VDT/ICO	MP/BP/UB	20.9	PP	PP	SE	SE	M	L
53a	E1	27	27	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	UR	UR	H	L
53b	E1	28	28	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	0.0	PP	PP	SE	SE	M	L
53c	E1	22	0	Helicopter	VDT/ICO	——	MP/BP/JP/UB	0.3	PP	PP	UR	SE	H	L
53d	E1	22	0	Skyline	VDT/ICO	——	MP/BP/JP/UB	5.7	PP	PP	SE	SE	H	L
54	E1	80	80	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	5.1	DF	PP	SE	SE	H	L
55	E1	23	23	Skyline/Ground	VDT/ICO	VDT/ICO	MP/BP/UB		GF	PP	SE	SE	H	L
56	E1	31	31	Skyline	VDT/ICO	VDT/ICO	MP/BP/JP/UB	9.3	DF	PP	OFSS	OFSS	H	L
56a	E1	110	110	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	4.6	DF	PP	SE	SE	H	L
57	E1	12	12	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB		DF	PP	UR	SE	M	L
57a	E1	122	122	Ground	VDT/ICO	VDT/ICO	MST/UB	5.6	DF	PP	UR	SE	H	L
57b	E1	32	32	Helicopter	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	UR	SE	M	L
58	E1	106	106	Skyline/Ground	VDT/ICO	VDT/ICO	MP/BP/UB	5.8	DF	PP	UR	SE	H	L
59	E1	27	27	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	0.3	PP	PP	UR	SE	H	L
5a	E1	0	0	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	0.2	PP	PP	SE	SE	M	L
6	E1	86	0	Ground	VDT/ICO	——	MP/BP/UB		PP	PP	SE	SE	L	L
60	C3	19	19	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	SE	SE	H	L
60a	C3	58	58	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	8.2	DF	PP	OFSS	OFSS	H	L
60b	C3	10	10	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB		DF	PP	SE	SE	H	L
61	E1	64	64	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	OFMS	OFMS	H	L
61a	E1	11	11	Skyline	VDT/ICO	VDT/ICO	MP/BP/JP/UB		GF	GF	OFMS	OFMS	H	L
62	E1	37	37	Skyline	VDT/ICO	VDT/ICO	MP/BP/JP/UB		PP	PP	UR	SE	H	L

Unit	MA	Alt 2 Acres	Alt 3 Acres	Harvest System	Alt 2 Forest Veg Treatment	Alt 3 Forest Veg Treatment	Alt 2 Fuels Treatments	Class 4 Tmt Acres	Pre-Treat CT	Post-Treat CT	Pre-Treat SS	Post-Treat SS	Pre-Treat DC	Post-Treat DC
63	E1	48	48	Skyline	VDT/ICO	VDT/ICO	MP/BP/JP/UB		PP	PP	UR	SE	H	L
65	E1	89	89	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	1.1	PP	PP	UR	SE	M	L
65a	E1	49	49	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	UR	SE	H	L
65b	E1	47	0	Ground	VDT/ICO	——	MP/BP/UB		DF	PP	UR	SE	H	L
67	E1	29	29	NCT	NCT	NCT	UB	11.8	PP	PP	OFSS	OFSS	H	L
68	C3	243	243	Ground	VDT/ICO	VDT/ICO	MST/UB	3.2	DF	PP	UR	SE	H	L
68a	C3	17	17	Skyline	VDT/ICO	VDT/ICO	MP/BP/JP/UB	5.2	DF	PP	SE	SE	H	L
68b	C3	49	49	Skyline	VDT/ICO	VDT/ICO	MP/BP/JP/UB		DF	PP	SE	SE	H	L
68c	C3	27	0	Helicopter	VDT/ICO	——	MP/BP/JP/UB		DF	PP	OFSS	OFSS	H	L
68d	C3	48	48	NCT	NCT	NCT	UB		PP	PP	SE	SE	H	L
69	E1	43	43	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	2.4	DF	PP	SE	SE	H	L
69a	E1	94	94	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	0.5	PP	PP	UR	SE	H	L
69b	C3	8	8	NCT	NCT	NCT	UB		DF	PP	OFSS	OFSS	H	L
69c	E1	76	76	NCT	NCT	NCT	UB	2.9	DF	PP	OFSS	OFSS	H	L
7	E1	54	0	Ground	VDT/ICO	——	MP/BP/UB	4.4	DF	PP	UR	SE	H	L
70	C3	176	176	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	9.8	PP	PP	SE	SE	M	L
70a	C3	80	0	Helicopter	VDT/ICO	——	MP/BP/JP/UB		DF	PP	OFSS	OFSS	H	L
71	C3	281	281	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	37.2	PP	PP	UR	SE	H	L
71a	C3	403	403	NCT	NCT	NCT	UB	34.5	DF	PP	UR	SE	H	L
72	C3	143	143	Ground	VDT/ICO	VDT/ICO	MP/BP	11.4	DF	PP	SE	SE	H	L
73	C3	59	59	Ground	VDT/ICO	VDT/ICO	MST/UB		PP	PP	UR	SE	H	L
74	E1	25	25	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		GF	PP	OFMS	OFMS	H	L
75	E1	44	44	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	UR	SE	M	L
76	E1	60	60	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	SE	SE	H	L
77	E1	21	21	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	OFMS	OFMS	H	L
78	E1	10	10	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	1.9	DF	PP	SE	SE	M	L
79	A4	65	65	Skyline/Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB	16.6	PP	PP	OFSS	OFSS	H	L
7a	E1	8	8	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	1.2	DF	PP	UR	SE	H	L
8	E1	31	31	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	1.1	PP	PP	SE	SE	L	L
80	A4	27	27	Helicopter	VDT/ICO	VDT/ICO	MP/BP/JP/UB		DF	PP	UR	SE	M	L
81	E1	17	0	Ground	VDT/ICO	——	MP/BP/UB		PP	PP	SE	SE	L	L
82	E1	40	0	Skyline	VDT/ICO	——	MP/BP/JP/UB		GF	PP	SE	SE	M	L
83	E1	50	50	Skyline	VDT/ICO	VDT/ICO	MP/BP/JP/UB		PP	PP	OFMS	OFMS	H	L

Unit	MA	Alt 2 Acres	Alt 3 Acres	Harvest System	Alt 2 Forest Veg Treatment	Alt 3 Forest Veg Treatment	Alt 2 Fuels Treatments	Class 4 Tmt Acres	Pre-Treat CT	Post-Treat CT	Pre-Treat SS	Post-Treat SS	Pre-Treat DC	Post-Treat DC
84	C3	71	71	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	1.2	PP	PP	UR	SE	M	L
85	E1	13	13	Skyline	VDT/ICO	VDT/ICO	MP/BP/JP/UB	5.8	PP	PP	UR	SE	H	L
86	E1	82	82	Skyline	VDT/ICO	VDT/ICO	MP/BP/JP/UB	32.9	GF	PP	UR	UR	H	L
87	E1	21	21	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	SE	SE	M	L
88	E1	54	54	Ground	VDT/ICO	VDT/ICO	MST/UB	2.7	PP	PP	UR	SE	H	L
89	E1	56	56	Ground	VDT/ICO	VDT/ICO	MST/UB	1.3	PP	PP	UR	SE	H	L
9	E1	37	37	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	0.9	PP	PP	SE	SE	H	L
90	E1	130	130	Ground	VDT/ICO	VDT/ICO	MST/UB		PP	PP	UR	SE	M	L
91	C3	79	79	Ground	VDT/ICO	VDT/ICO	MST/UB		PP	PP	UR	SE	H	L
92	C3	34	34	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	UR	SE	H	L
93	C3	62	62	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	10.9	DF	PP	OFSS	OFSS	H	L
94	C3	86	86	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	6.8	PP	PP	OFMS	OFSS	H	L
95	C3	7	7	Ground	VDT/ICO	VDT/ICO	MST/UB	2.1	DF	PP	OFSS	OFSS	H	L
96	C3	42	42	Ground	VDT/ICO	VDT/ICO	MP/BP	1.4	PP	PP	UR	SE	M	L
97	C3	25	25	Ground	VDT/ICO	VDT/ICO	MP/BP	0.3	DF	PP	UR	SE	H	L
98	E1	25	0	Ground	VDT/ICO	——	MP/BP/UB		PP	PP	UR	SE	L	L
99	E1	165	165	Ground	VDT/ICO	VDT/ICO	MP/BP/UB	0.2	PP	PP	UR	SE	H	L
CG-1	A4	18	18	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	OFMS	OFMS	H	L
LO-1	E1	12	12	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	OFMS	OFSS	H	L
LO-2	C1	18	18	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		DF	PP	SE	SE	H	L
LO-3	E1	3	3	Ground	VDT/ICO	VDT/ICO	MP/BP/UB		PP	PP	OFMS	OFSS	H	L
Total		12224	11544					681						

Sources/Notes: Derived from the Kahler vegetation database. MA refers to management allocation (see Management Direction section and table 15). Treatment acreages are approximate, and they agree with the affected environment summary presented in table 6 (12,220 'unique' acres for alternative 2 and 11,540 'unique' acres for alternative 3, considering that all table values in this report are rounded to the nearest 10 acres (except the detailed summary presented in this appendix, where Alt 2 Acres and Alt 3 Acres are rounded to nearest whole acre, and Class 4 Tmt Acres are rounded to nearest tenth-acre). 'Unique' acres are sometimes referred to as 'footprint' acres – these acres receive some type of forest vegetation treatment, but note that some footprint acres receive more than one treatment because an acre may receive a VDT/ICO commercial thinning treatment in year 1, followed by a noncommercial thinning treatment in years 2 or 3, and eventually followed by one or more fuels treatments beyond year 3. For this scenario, the same acre would be counted three times (in table 1, for example, some acres are shown with an asterisk to denote they are counted more than once as a result of this situation).

The 'Harvest System' column provides estimated timber harvest systems to be used to remove timber products from units. These harvest system assignments are based on the best information available when this environmental analysis was conducted (based primarily on preliminary unit layout during project reconnaissance activities), and they are subject to modification during final project design and layout.

Alt 2 and Alt 3 Forest Vegetation Treatments are shown with these codes: VDT/ICO = Variable Density Thinning/Individuals, Clumps and Openings, with either commercial thinning variant implemented with skips and gaps; NCT = noncommercial thinning; NCT-JUOC = noncommercial thinning specifically targeted at western juniper reduction; and S-S = shrub-steppe enhancement, a thinning approach directed toward restoration of bitterbrush and other shrublands (some S-S treatment acreage also includes NCT).

The Fuels Treatments column provides estimated fuels treatment methods directed primarily toward reduction of activity fuels created by forest vegetation treatments such as commercial or noncommercial thinning. These fuels treatment assignments are based on the best information available when this environmental analysis was conducted (primarily on preliminary unit layout and project reconnaissance activities), and they are subject to modification during final project design and layout. Alt 2 fuels treatments are shown with these codes: MP=machine pile; BP=burn piles; JP=jackpot burn; UB=underburn; MST=mastication. Fuels treatments vary slightly for alternative 3, and they are shown in the fuels specialist report (Marshall 2014). Wide-area, landscape-level prescribed fire is not included in the fuels treatments column; refer to the fuels specialist report for information about application of landscape-scale prescribed fire (Marshall 2014).

The 'Class 4 Tmt Acres' shows the estimated acreage of class IV RHCAs proposed for treatment in the proposed action (alternative 2). Some of the specifications and considerations related to class IV vegetation treatments are described in this report in a Dry Forest RHCA Thinning section (pages 9-13).

The Pre-treatment (Pre-Treat) and Post-treatment (Post-Treat) columns provide characterizations of species composition (as Cover Types, or CT), forest structure (as Structural Stage, or SS), and stand density (as Density Class, or DC). Note that information presented in these six columns is generalized, and it only represents average conditions for a treatment unit, both pre-treatment (2012, representing conditions following completion of stand exams and field reconnaissance activities – see Methodology section in this report), and post-treatment (2015, representing conditions immediately after implementation of the first timber-removal project in the Kahler planning area).

Cover type codes are: DF = Douglas-fir; GF = grand fir; PP = ponderosa pine; WJ = western juniper.

Structural stage codes are: OFMS = Old Forest Multi Strata; OFSS = Old Forest Single Stratum; SE = Stem Exclusion; UR = Understory Reinitiation.

Density class codes are: L = Low; M = Moderate; H = High.

Important Note: the forest vegetation analysis for the Kahler Dry Forest Restoration Project is based on vegetation polygons (see Methodology section). The units shown in the first column of this table are <u>not</u> vegetation polygons as used for Kahler vegetation analyses. Treatment units are an aggregation of adjoining vegetation polygons – some of the larger units in this table (note that many units are greater than 100 acres in size, and some are in the 300-400 acre range) were formed by combining a dozen or more vegetation polygons. Since the vegetation analyses are based on polygons delineated at a much finer scale than treatment units, the pre- and post-treatment vegetation conditions presented in the last 6 columns of this table were derived by inspecting the polygon data and then 'averaging' cover type, structural stage, and density class codes for polygons making up a unit. They provide a general estimate of pre- and post-treatment conditions, but it would not be appropriate to sum the treatment acreages for units with a certain cover-type code, for example, and then attempt to compare the result with any other cover-type data presented in this report because *report data was derived from vegetation polygons, not from treatment units*.

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Abbreviations and Acronyms

abh	age at breast height (years)
AE	affected environment
BA	basal area
BAA	basal area per acre
BE	biophysical environment
BLM	Bureau of Land Management
BMFP	Blue Mountains Forest Partners (a collaborative group)
CFR	Code of Federal Regulations
CT	cover type (an indicator of the species composition resource element)
CVS	Current Vegetation Survey (an inventory system)
dbh	diameter at breast height (inches)
DC	desired condition (meaning for most instances in this report)
DC	density class (an indicator of the stand density resource element; only used for table 55)
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
EIS	Environmental Impact Statement
FEIS	Final Environmental Impact Statement
FP	Forest Plan (e.g., Land and Resource Management Plan for Umatilla NF)
FR	fire regime
FRCC	Fire Regime Condition Class
FSVeg	Field Sampled Vegetation database application
FVS	Forest Vegetation Simulator
GAO	General Accounting Office (or Government Accountability Office)
GIS	geographical information system
GLO	General Land Office
GPS	global positioning system
HRV	historical range of variation (historical range of variability)
HUC	hydrologic unit code
ICO	Individuals, Clumps, and Openings
IPCC	Intergovernmental Panel on Climate Change
ISBN	International Standard Book Number
LOS	late-old structure
LRMP	Land and Resource Management Plan
MSLT	multi-strata with large trees
MSN	Most Similar Neighbor
MTBS	Monitoring Trends in Burn Severity
NCT	noncommercial thinning
NEPA	National Environmental Policy Act
NF	National Forest or Nonforest (depending on context)

NFMA	National Forest Management Act
NFS	National Forest System
NRDC	Natural Resources Defense Council
OFSS	old forest single stratum forest structural stage
OFMS	old forest multi-strata forest structural stage
PA	proposed action
PACFISH	Interim Strategies for Managing Anadromous Fish-Producing Watersheds on Federal Lands in Eastern Oregon and Washington, Idaho and Portions of California
PAG	plant association group
PDF	portable document format
PVG	potential vegetation group
PVT	potential vegetation type
QMD	Quadratic Mean Diameter
RD	Ranger District
RHCA	riparian habitat conservation area
RV	range of variation
SDI	stand density index
SE	stem exclusion forest structural stage
SI	stand initiation forest structural stage
SS	structural stage (an indicator of the forest structure resource element)
SSLT	single stratum with large trees
UF	upland forest
UR	understory reinitiation forest structural stage
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
VDT	variable-density thinning
WUI	wildland-urban interface

Glossary

Active management. Human intervention into the nature, extent, and timing of disturbance to wildland ecosystems for the purpose of obtaining desired goods and services (Haeussler and Kneeshaw 2003). It has also been defined as the use of planning, thinning, prescribed fire, timber harvest, and reforestation to intentionally influence the health and resilience of a forest. In a climate-change context, active management refers to responses supporting ecosystem changes related to climate change (such as assisted species migration). For the Kahler project, active management involves application of silvicultural activities to modify existing vegetation conditions and move them toward desired vegetation conditions.

Activity fuel. Combustible material resulting from, or altered by, forestry practices such as timber harvest or thinning, as opposed to naturally created fuels (Helms 1998). Compare with: *natural fuel*. Also see: *fuel*.

Adaptation. A far-term climate change strategy adopting tactics such as minimizing negative ecosystem effects (reforest now with tree species expected to be tolerant of future droughts), or by exploiting potential opportunities to adapt to future climatic conditions. Adaptation is sometimes considered to be analogous with resilience. Adaptation and mitigation are important strategies, in some combination, to address climate change. For the Kahler project, both near-term mitigation and far-term adaptation actions are planned, as described in the climate change section of this report.

Adaptive management. A dynamic approach to land management in which the effects of treatments and decisions are continually monitored and used, along with research results, to modify management on a continuing basis to ensure that objectives are being met (Helms 1998).

Affected environment. In a NEPA context, this is a description of the environment of area to be affected by the alternatives under consideration (40 CFR 1502.15). For the Kahler project, the affected environment, as defined for forest vegetation analyses, does not include NFS lands in management areas designated as unsuitable for timber production (A6, C1, D2), except for a small portion (app. 30 acres) included in a site-specific FP amendment to authorize vegetation treatments adjacent to an administrative site (Tamarack fire lookout).

Bark beetles. Small, often cylindrical beetles in the family Scolytidae that bore through the bark of host trees to lay their eggs and, as larvae, they tunnel and feed in the inner bark (Doliner and Borden 1984). For the Kahler project, bark beetles of particular concern include: Douglas-fir beetle, which affects older and larger Douglas-fir; mountain pine beetle, which affects second-growth ponderosa pine forest; fir engraver, which affects older and larger grand fir; and western pine beetle, an important killer of older and larger ponderosa pine.

Basal area. The surface area of a woody stem (or stems), including bark, as if cut off at a certain height (such as breast height or 4½ feet above the ground); also, the surface area of all stems in a stand and expressed per unit of land area (basal area per acre) (Jennings et al. 2003). Basal area is a way to measure how much of a site is occupied by trees. For the Kahler project, stand density index (SDI) is a stocking metric used to formulate suggested stocking levels, although SDI values are translated into their corresponding basal area values when preparing marking guides for operational timber designation activities.

Biological diversity (biodiversity). The variety of all fauna, flora, and microbes, and their habitats. Biodiversity is hierarchical, ranging from genetic diversity to species diversity and then ultimately ecosystem diversity (Powell et al. 2001).

Biophysical environment. Landscape-level unit of vegetation composition and structure, with its associated environmental gradients and processes of change (Powell et al. 2007). Note that 'biophysical' refers to a combination of biological and physical components of an ecosystem. For the Kahler project, potential vegetation groups (PVGs) are used as biophysical environments – most of the Kahler planning area (app. 87%) consists of the dry upland forest biophysical environment (PVG).

Breast height. A standard height from ground level, generally 4.5 feet (1.37 m), for recording diameter, circumference (girth), age, or basal area of a tree (adapted from Helms 1998). Measurement at breast height is usually taken on the uphill side of the tree and includes any duff layer that may be present, but does not include unincorporated woody debris lying upon the ground surface (Helms 1998). For the Kahler project, tree diameter is measured at breast height (e.g., diameter at breast height, or dbh).

Breast-height age. The number of rings from the center (pith) of a tree to the cambium layers, and counted at breast height (Helms 1998). For the Kahler project, tree age is determined by using an increment borer to extract an increment core from a tree at breast height (same point on stem where diameter is measured), and then counting the annual rings from the pith to the cambium. For the Kahler project, tree age is measured at breast height (e.g., age at breast height, or abh).

Burn severity. Fire severity and burn severity are sometimes used interchangeably. Note that burn severity relates specifically to soils, particularly to the loss of organic matter from, and directly above, the mineral soil (Keeley et al. 2009). Compare with: *fire severity*.

Climax. The culminating seral stage in plant succession for any given site where, in the absence of catastrophic disturbance, the vegetation has reached a highly stable condition and undergoes change very slowly (Dunster and Dunster 1996). The stage of plant development in which vegetation is thought to be stable, self-sustaining, and self-replicating. Also refer to: *seral stage: potential natural community*.

Cohort. A group of trees developing after a single disturbance, commonly consisting of trees of similar age, although one cohort can include a considerable span of ages ranging from seedlings or sprouts to trees that predated the disturbance (Helms 1998). Stands are often characterized as single-cohort or multi-cohort depending on whether they contain one or several cohorts (Oliver and Larson 1996). The Kahler planning area contains two multi-cohort structural stages – understory reinitiation and old forest multi-strata, and three single-cohort structural stages – stand initiation, stem exclusion, and old forest single stratum. Also see: *structural stage*.

Commercial thinning. Any type of tree thinning producing merchantable material at least equal in value to the direct costs of timber harvest. For the Kahler project, commercial thinnings will be implemented using two primary approaches – variable-density thinning with skips and gaps, and the individuals, clumps, and openings (ICO) method, also with skips and gaps.

Community. In an ecological context, a community is made up of all of the interacting populations in an environment. Community refers to a group of organisms that tends to occur together under similar environmental conditions, occupying the same habitat or area and interacting with each other (Doliner and Borden 1984). Community is usually considered to be a smaller spatial scale than an ecosystem.

Competition. Negative interactions between individuals of either the same or different species that utilize common and limited resources such as nesting sites, nutrients, or prey (Doliner and Borden 1984). For trees, competition results in a density-related scarcity of certain environmental factors, primarily relating to soil moisture and nutrients, that are important for tree growth and survival (Helms 1998).

Connectivity. Ecological conditions existing at several spatial and temporal scales and providing landscape linkages to permit the exchange of water flow, sediments, and nutrients; daily and seasonal movements of animals within home ranges; dispersal and genetic interchange between populations; and long distance range shifts of species, such as in response to climate change (USDA Forest Service 2012a). For the Kahler project, the width and location of connectivity corridors are influenced by requirements from the Eastside Screens amendment to the Forest Plan.

Cover type. The plant species forming a plurality of the composition across a given land area, e.g., the Engelmann spruce-subalpine fir, ponderosa pine-Douglas-fir, or lodgepole pine forest cover types (Helms 1998). Forest cover types of the United States and Canada are described in Eyre (1980). Rangeland cover types of the United States are described in Shiflet (1994). For the Kahler project, cover type assignments are based on vegetation characteristics derived from the Most Similar Neighbor imputation process (see Methodology section of this report).

Crown class. A categorization or classification of trees based on their crown position relative to adjacent trees within the same canopy stratum; four primary crown classes are recognized:

Dominant. A tree whose crown extends above the general level of the main canopy, receiving full light from above and partial light from the sides.

Codominant. A tree whose crown helps to form the general level of the main canopy, receiving full light from above and limited light from the sides.

Intermediate. A tree whose crown extends into the lower portion of the main canopy but is shorter than the codominants, receiving little direct light from above and virtually none from the sides.

Subcanopy (overtopped). A tree whose crown is completely overtopped by the crowns of one or more neighboring trees, occurring in a subordinate or submerged position relative to the main canopy.

Crown fire. An intense fire that burns through the upper tree or shrub canopy, spreading from one woody crown to another above the ground. In most cases the understory vegetation is also burned. Depending on species, a crown fire may or may not be lethal to all dominant vegetation. An example of this would be many shrub and broadleaf tree species that sprout from roots, root crowns, or stem bases after their tops are killed. A crown fire may be continuous, or it may occur as patches within a lower severity burn (Sommers et al. 2011). Three types of crown fire are commonly recognized:

Passive crown fire. This crown fire type is characterized by the torching of a small group of trees (Stephens et al. 2012); a solid or continuous flaming front, in canopy fuels, cannot be maintained except for short periods.

Active crown fire. This crown fire type is characterized by fire spreading continuously in canopy fuels. Two types of active crown fire are recognized:

Independent crown fire. This crown fire type spreads without the aid of a supporting surface fire (Sommers et al. 2011). For example, a strongly wind-driven, independent crown fire is sometimes observed in boreal forest during late winter or spring when snow still covers surface fuels.

Dependent crown fire. This crown fire type spreads in canopy and surface fuels simultaneously (Stephens et al. 2012). For the Kahler project, many of the silvicultural activities proposed for implementation, including prescribed fire, are designed to minimize future risk of dependent crown fire.

Danger tree. A tree, or its parts, that is likely to fail within one and ½ tree lengths of an open class 3 or higher system road, any road designated for timber hauling, or a developed recreation or administrative site (Toupin et al. 2008). Also known as: *hazard tree*. The Kahler project includes design features and other measures to address danger trees along travel routes.

Desired future conditions (desired conditions). A description of the land or resource conditions that are believed necessary if goals and objectives are to be fully achieved (Helms 1998). For the Kahler project, forest vegetation desired conditions are based primarily on ranges of variation for species composition, forest structure, and stand density.

Disease. Any more or less prolonged disturbance of an organism that interferes with its normal structure or function; the causes of disease are both biotic and abiotic (Doliner and Borden 1984). For the Kahler project, the primary diseases of concern involve parasitic dwarf mistletoes affecting Douglas-fir, ponderosa pine, and western larch; Armillaria and annosus root diseases; and rust-red stringy rot stem decay in grand fir caused by Indian paint fungus (Schmitt and Spiegel 2010, 2012).

Disturbance. A relatively discrete event that disrupts the structure of an ecosystem, community, or population, and changes resource availability or the physical environment. Disturbances include processes such as fires, floods, insect outbreaks, disease epidemics, and windstorms (Dodson et al. 1998). For the Kahler planning area, the primary disturbance processes of historical importance include wildfire, and defoliation of mixed-conifer forests by western spruce budworm and Douglas-fir tussock moth.

Disturbance regime. A description of the characteristic types of disturbance on a given landscape; the frequency, severity, and size distribution of these characteristic disturbance types; and their interactions (USDA Forest Service 2012a). Description of a disturbance regime would include characteristics such as the spatial distribution of disturbance events; disturbance frequency (number of disturbance events in a specified time interval, or the probability of a disturbance event occurring within a particular time interval); return interval (average time between successive disturbance events); rotation period (length of time until an area equivalent to the size of an analysis area would be affected in one disturbance event); disturbance size; and the magnitude, or intensity, of a disturbance event (Dodson et al. 1998).

Dripline. The width of a tree crown, measured as the outermost point at which a drop of water would fall vertically from the crown foliage and reach the ground rather than other foliage. It is expressed as either a radial distance from the tree trunk (bole, stem) to the dripline, or as a diameter of the area encompassed from one edge of the dripline to the other (Dunster and Dunster 1996) (see fig. 24 for an illustration). For the Kahler project, dripline is defined as a radial distance measured from the tree stem to the outermost extent of the tree's crown (fig. 24).

Dry upland forest. A potential vegetation group associated with biophysical environments where the climate, soil depth, and other physical site factors allow development of a tree-dominated ecosystem supporting vegetation types characteristic of relatively warm or hot temperature conditions, and dry or xeric moisture regimes (Powell et al. 2007). For the Kahler planning area, the primary biophysical environment includes lands assigned to the Dry Upland Forest potential vegetation group – app. 87% of the 32,840-acre planning area is Dry Upland Forest.

Eastside Screens. A Regional Forester's Plan Amendment establishing riparian, ecosystem, and wildlife standards specifically for timber sales. For the Kahler project, an amendment to the wildlife screen is proposed for two reasons: (1) to authorize removal of some of the young (< 150 years abh) but large (≥ 21" dbh) grand fir and Douglas-fir trees when they are competitively interacting (defined as a 2-dripline distance) with desirable trees; and (2) to complete understory thinning treatments in the old forest single stratum forest structural stage in order to increase its future resiliency, and to allow safe reintroduction of low-severity surface fire in fire-dependent, dry-forest ecosystems.

Ecological integrity. The quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation, and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence (USDA Forest Service 2012a).

Ecosystem. A spatially explicit, relatively homogeneous unit of the Earth that includes all interacting organisms and elements of the abiotic environment within its boundaries. An ecosystem is commonly described in terms of its: (1) Composition. The biological elements within the different levels of biological organization, from genes and species to communities and ecosystems. (2) Structure. The organization and physical arrangement of biological elements such as, snags and down woody debris, vertical and horizontal distribution of vegetation, stream habitat complexity, landscape pattern, and connectivity. (3) Function. Ecological processes that sustain composition and structure, such as energy flow, nutrient cycling and retention, soil development and retention, predation and herbivory, and natural disturbances such as wind, fire, and floods. (4) Connectivity. (USDA Forest Service 2012a). Also see: *connectivity*.

Ecosystem services. Ecosystem services include provisioning services such as food, water, timber, and fiber; regulating services affecting climate, floods, disease, wastes, and water quality; cultural services providing recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling (Hassan et al. 2005). For the Kahler project, implementation of silvicultural activities is projected to enhance all four categories of ecosystem services.

Even-aged stand. A stand of trees composed of a single age class (USDA Forest Service 2012a).

Existing vegetation. Vegetation found at a given location at the time of observation (Jennings et al. 2003). Compare with: *potential vegetation*. For the Kahler project, existing vegetation characterizations are based on vegetation attributes derived from the Most Similar Neighbor imputation process (see Methodology section of this report).

Fire. A self-sustaining chemical reaction releasing energy in the form of light and heat (Brenner 1998). Four types of fire are commonly recognized (arranged from least intense to most intense):

Ground fire. Fires burning in surface organic materials such as peat or deep duff layers. Ground fires typically undergo a large amount of smoldering combustion and less active flaming than other fire types. They may kill roots of overstory species due to prolonged high temperatures in the rooting zone (Sommers et al. 2011). [Although the terms are often used interchangeably, and incorrectly so, *ground fire is not the same as surface fire*.]

Surface fire. Fires burning only the lowest vegetation layer, which may consist of grasses, herbs, low shrubs, mosses or lichens (live fuels), and dead tree foliage and branchwood cast into the surface fuelbed from the overstory canopy. In forests, woodlands, or savannas, surface fires are generally low to moderate severity, and do not cause extensive overstory mortality (Sommers et al. 2011). For the Kahler project, surface fire was by far and away the most common fire type historically because it affected both dry upland forest sites and nonforest environments.

Mixed-severity fire. For this fire regime, fire severity varies between nonlethal understory fire and lethal stand replacement fire, with the variation occurring in space (between polygons) or time (within the same polygon). In some vegetation types, the stage of succession, the understory vegetation structure, the fuel condition, or the weather may determine whether a low or high-severity (or surface or crown) fire occurs. In this scenario, individual fires vary over time between low-severity surface fires and longer-interval stand replacement fires. In other situations, the severity may vary spatially as a function of landscape complexity or vegetation pattern, in which case the result may be a mosaic of young, old, and multi-aged vegetation patches (Sommers et al. 2011).

Stand replacement fire. A fire that is lethal to most of the dominant, above-ground vegetation, with the result that it substantially changes the vegetation structure. Stand replacement fires may occur in forests, woodlands and savannas, annual grasslands, and shrublands. Depending on the vegetation type being affected, stand replacement fire may result from crown fire, high-severity surface fire, or ground fire (Sommers et al. 2011). Also see: *crown fire*.

Fire behavior. This term relates to the manner in which fire reacts to fuel, weather, and topography; common terms used to describe fire behavior include smoldering, creeping, running, spotting, and torching (Sommers et al. 2011).

Fire exclusion. Areas where wildland fires were eliminated, including areas historically exposed to traditional Native American burning (Rapp 2002). For the Kahler project, fire exclusion is believed to have exerted the most influence on existing forest conditions, although historical levels of selective timber cutting and ungulate grazing also played important roles (Powell 2014a).

Fire frequency. The number of times that fire occurs within a defined geographical area and during a specific time period. Fire frequency is sometimes characterized by using fire return intervals: very frequent (0-25 years between fires); frequent (26-75 years); and infrequent (76-150 or more years) (Sommers et al. 2011).

Fire intensity. Fire intensity describes the physical combustion process of energy release from organic matter. It is often expressed as fireline intensity – the rate of heat transfer per unit length of fireline. Since there is often a consistent relationship between fireline intensity and flame length, flame length may be used as a measure of fireline intensity (Keeley et al. 2009). Three intensity classes are recognized: low (average flame length of less than 3 feet), intermediate (average flame lengths of 3 to 9 feet), and high (flame lengths exceed 9 feet).

Fire regime. A fire regime is a generalized description of the role fire plays in an ecosystem (Agee 1993). When characterizing a fire regime, the following attributes are often included: frequency, magnitude (intensity and/or severity), variability, seasonality, synergism, and extent (Agee 1998). Note that many fire regime classification systems exist; a recent one recognizes three primary regimes for forested environments (Brown and Smith 2000): (1) understory – fires are generally nonlethal to dominant vegetation (80% or more survives), and they do not change its structure; (2) mixed severity – fire either causes selective mortality in dominant vegetation (depending on its fire tolerance), or it varies between the understory and stand-replacement modes; and (3) stand replacement – fire kills or consumes the dominant vegetation (80% or more is either killed or consumed), and the forest structure is changed substantially. Compare with: *disturbance regime*.

Fire return interval. This metric describes the time between fires in a defined area, usually at the scale of a point, stand, or relatively small landscape area. This is called Mean Fire Interval (MFI) in the LANDFIRE system, when it refers to the average number of years between fires in representative stands (Barrett et al. 2010).

Fire severity. Fire severity relates to the loss (death) or decomposition of organic matter both aboveground and belowground, including tree mortality as a 'loss' component, but this mortality context is most appropriate for trees lacking any sprouting capacity. Fire severity is correlated with fire intensity (Keeley et al. 2009). Compare with: *fire intensity*. For forest vegetation analyses for the Kahler project, fire effects are typically characterized as fire severity, because they relate directly to tree mortality, rather than fire intensity.

Fire suppression. All activities associated with controlling and extinguishing a fire following its detection (Dunster and Dunster 1996). Compare with: *fire exclusion*.

Forest. An ecosystem characterized by more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species composition, structure, age class, and associated processes, and commonly including meadows, streams, fish, and wildlife (Helms 1998).

Forest density management. Cutting or killing trees to increase inter-tree spacing and accelerate growth of remaining trees; the manipulation and control of forest (tree) density to achieve one or more resource objectives. Forest density management is often used to improve forest health, to open the canopy for selected trees, to maintain understory vegetation, or to promote late-successional characteristics for biological diversity (Helms 1998). For the Kahler project, forest density management activities include commercial, noncommercial, and juniper/shrub-steppe thinnings.

Forest floor. A general term encompassing the layer of undecomposed organic matter (leaves, twigs, and plant remains in various stages of decomposition) lying on top of the mineral soil (Dunster and Dunster 1996).

Forest health. The perceived condition of a forest based on concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance. Note that perception and interpretation of forest health is influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of stands comprising the forest, and the appearance of a forest at any particular point in time (Helms 1998).

Forest management. Intentional manipulation of forest ecosystems to influence their composition, structure, or density, and the nature of the products and services they provide (Burger 2009). Also see: *active management*. For the Kahler project, forest management involves application of silvicultural activities to modify existing vegetation conditions and move them toward desired vegetation conditions.

Forest stand. A contiguous group of trees sufficiently uniform in age-class distribution, composition and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit (Helms 1998). For the Kahler project, forest stands (e.g., vegetation polygons) were used as the base-level planning unit, although similar stands are aggregated into treatment units when silvicultural activities are implemented on the ground.

Fuel. All of the dead and living material in an ecosystem that will burn; fuel includes grasses, dead branches and pine needles on the ground, as well as standing live and dead trees (Brenner 1998). Four types of fuel are commonly recognized (arranged from lowest to highest):

Ground fuel. A fuel component consisting of duff (the Oi soil horizon) and other materials (such as peat) lying on top of a mineral soil surface; ground fuels generally do not contribute to wildfire spread or intensity (Stephens et al. 2012).

Surface fuel. A fuel component including dead and down woody materials, litter, grasses, other herbaceous plant material, and short shrubs; surface fuels may be the most hazardous fuel component for some forest types (Stephens et al. 2012). For the Kahler project, application of prescribed fire will be a primary activity for modifying or maintaining surface fuel conditions.

Ladder fuel. A fuel component consisting of small trees or tall shrubs providing vertical continuity from surface fuels to canopy (crown) fuels (Stephens et al. 2012). Ladder fuels are important for initiating crown fire, but they have little influence on crown fire spread. For the Kahler project, intermediate silvicultural treatments (thinnings) are a primary activity for addressing ladder-fuel objectives.

Crown fuel. A fuel component comprised of overstory tree crowns and canopies (including foliage and small branches); note that the canopy and crowns of small trees (seedlings and saplings) are often included in the ladder-fuels category. Of the three primary fuel components (surface, ladder, crown fuels), fire scientists often consider crown fuels to be the least hazardous (Stephens et al. 2012), but my experience is that this sentiment is seldom shared by managers and practitioners. Crown fuels are typically quantified as canopy bulk density – the mass of available canopy fuel per unit of canopy volume, often expressed as kilograms per cubic meter. For the Kahler project, intermediate silvicultural treatments (thinnings) are a primary activity for addressing ladder-fuel objectives.

Fuel load. The amount of combustible material (living and dead organic matter) that is found in an area (Brenner 1998).

Fuel management or treatment. Any manipulation or removal of fuels to reduce the likelihood of fire ignition, lessen potential fire-caused damage, and improve resistance to control. For the Kahler project, fuel management activities (treatments) will be directed by silvicultural prescriptions, marking guides, and burn plans.

Gap. In forestry usage, a gap is a space left in the canopy when one or more trees die, or after they are removed during timber harvest. For the Kahler Dry Forest Restoration Project, gaps are used in association with variable-density thinning to create habitat for regeneration of shade-intolerant species including shrubs and herbs (Franklin et al. 2013). Compare with: *skip*.

Grapple piling. This fuels treatment activity utilizes mechanical equipment to pile woody material from two to nine inches in diameter and more than six feet in length. Grapple-piling treatments are designed so that residual fuel loading (after piles are burned or otherwise treated) will meet objectives established for the Kahler project.

Growing space. An intangible measure of the total resources of a site (sunlight, moisture, nutrients, etc.) available to a plant (Helms 1998). Growing space refers to the availability of all resources needed by a plant to exist on a given site (O'Hara 1996).

Harvest. See: *timber harvest*.

Hazard. Stand, tree, and environmental characteristics that are conducive to an insect outbreak or disease infection (Doliner and Borden 1984). The term hazard is also used to describe a tree, or its parts, that could fail and injure or kill people (see: *danger tree*). Compare with: *susceptibility*. The Kahler project includes design features addressing hazard trees in developed recreation sites, and danger trees located along roads and other travel routes.

ICO (Individuals, Clumps, and Openings). The ICO thinning "approach provides quantitative targets for spatial pattern based on historical or contemporary reference sites. Pattern is expressed in terms of the number of individual trees, and small, medium, and large tree clumps to leave in a stand (Churchill et al., 2013). Instead of marking for a specific range of basal areas, marking crews identify and track the number of clumps they retain while incorporating other leave tree criteria" (Franklin et al. 2013, p. 122). The specifics of ICO implementation are described in Churchill et al. (2013b). For the Kahler project, ICO is considered to be a variant of the VDT with skips and gaps approach. See: *variable density thinning*.

Indicator species. Species used to monitor environmental change or represent specific environmental conditions (Eycott et al. 2007), including plant species conveying information about the ecological nature of a site, such as the nitrogen content, or the alkalinity or acidity of its soils. These plant species have a sufficiently consistent association with a specific environmental condition, or with other species, such that their presence can be used to indicate or predict the environmental condition, or a potential for the other species (Kimmins 1997).

Intermediate cutting. Any cutting method used in a stand between the time of its formation (seedling stage) and its regeneration as a mature stand. Commercial thinning, noncommercial thinning, and improvement cutting are three examples of intermediate cutting methods. The Kahler project uses commercial and noncommercial thinnings when modifying existing vegetation conditions on upland-forest sites, within certain class IV RHCAs, and in shrub-steppe environments.

Irregular stand. A stand of trees characterized by variation in age structure or in the spatial arrangement of trees; stands without a uniform age or size structure (Helms 1998). Analysis of historical inventory data collected from mature stands in 1910-1911 (Munger 1917) suggests that dry-forest stands had a structure closer to irregular than to classical even-aged or classical uneven-aged (Powell 1999). This same analysis suggests that stocking levels developed for an even-aged structure (such as table 48) should be reduced by 7% to account for an irregular structure (Powell 1999, p. 20).

Keystone species. Species with ecosystem effects that are disproportionately large in comparison to their biomass or number (Eycott et al. 2007). The gopher tortoise, for example, is a keystone species because more than 330 other species use its burrows (Simberloff 1999). A keystone species does not need to refer solely to an animal – for the Kahler project, ponderosa pine is considered to be a keystone species for dry upland-forest biophysical environments.

Ladder fuel. See: *fuel*.

Landscape. A defined area irrespective of ownership or other artificial boundaries, such as a spatial mosaic of terrestrial and aquatic ecosystems, landforms, and plant communities, repeated in similar form throughout such a defined area (USDA Forest Service 2012a).

Landscape ecology. A study of structure, function, and change in a heterogeneous land area composed of interacting ecosystems (Forman and Godron 1986). Some landscape ecologists classify the spatial elements of a landscape into three primary components:

Matrix. The most extensive and most connected landscape element; it plays a dominant role in landscape function. The matrix is the landscape element surrounding a patch. For the Kahler project, 'matrix' is also used to refer to the main portion of a thinning unit where variable-density thinning will be applied – the skips and gaps portions of these thinning prescriptions are analogous to patches.

Patch. A nonlinear land area differing in appearance from its surroundings, which is typically the matrix. Patches are a landscape element distinct from the matrix and isolated from other similar areas (patches).

Corridor. A narrow, linear land feature differing from the matrix or a patch on either side. Riparian habitats along streams or rivers often function as corridors (Forman and Godron 1986). Class IV RHCAs traversing dry-forest biophysical environment in the Kahler planning area seldom differ from adjoining non-RHCA areas, so they would typically not function as a corridor.

Layer (vegetation). A structural component of a plant community consisting of plants of approximately the same height stature (e.g., tree, shrub, and herb layer); as defined here, synonymous with stratum (Jennings et al. 2003). For the Kahler project, one objective of proposed upland-forest treatments is to convert some portion of multi-layered forest structures (such as the UR and OFMS structural stages) into the more historically appropriate (for dry sites) single-layer structures (such as SE and OFSS).

Lifeform. The structure, form, habits, and life history of an organism. In plants, characteristic life forms such as forest (trees), shrubs, and herbs (forbs/graminoids) are based on morphological features (physiognomy or predominant stature) that tend to be associated with different environments (Allaby 1998).

Litter. Dead debris (plant material) covering the ground, including cones, needles or other shed foliage, branches, and other material (Brenner 1998).

Management area. A land area identified within the planning area that has the same set of applicable plan components. A management area does not have to be spatially contiguous (USDA Forest Service 2012a).

Marking guides. Marking guides are written direction, generally prepared by a certified or qualified silviculturist, to provide silvicultural guidelines or specifications for selecting trees to retain, or optionally trees to remove, in order to accomplish specific stand management objectives. Marking guides provide operational direction and guidelines to implement a detailed silvicultural prescription. They are written in such a way as to convey detailed specifications, and to clarify concepts and silvicultural terminology, related to why and how trees are selected and marked to implement a particular cutting method in a designated stand or treatment unit. For the Kahler project, marking guides will typically vary by cutting method and treatment unit.

Mastication. This fuels treatment activity utilizes mechanical equipment to chunk, pulverize, or grind, and scatter, both natural and harvest-generated fuels so that resulting fuelbed conditions will meet objectives established for the Kahler project.

Mechanical treatment. Mechanical treatment refers to the use of tractors or other machinery to remove trees in a tree harvest operation (stewardship harvest), or to the use of hand-operated tools (chain saws, axes, etc.) to cut, clear, thin, girdle or prune woody plant species (Powell et al. 2001). For the Kahler project, most of the silvicultural activities, except prescribed fire, will be implemented as mechanical treatments.

Mitigation. A near-term climate change strategy adopting tactics such as reducing greenhouse gas emissions (by reducing wildfire emissions, for example), or by enhancing carbon uptake and storage. Mitigation is sometimes considered to be analogous to resistance. Near-term mitigation and far-term adaptation are important strategies, in some combination, to address climate change. For the Kahler project, both near-term mitigation and far-term adaptation actions are planned, as described in the climate change section of this report.

Moist upland forest. A potential vegetation group associated with biophysical environments where the climate, soil depth, and other physical site factors allow development of a tree-dominated ecosystem supporting vegetation types that are characteristic of relatively moderate or intermediate temperature conditions, and a moist or mesic moisture regime (Powell et al. 2007). For the Kahler project, moist upland forest is one of two upland-forest biophysical environments, but its representation is very limited in the planning area (only 1% of the 32,840-acre planning area is Moist Upland Forest).

Monitoring. A systematic process of collecting information to evaluate effects of management actions, or changes in conditions or relationships (USDA Forest Service 2012a).

Native knowledge. A way of knowing or understanding the world, including traditional ecological and social knowledge of the environment derived from multiple generations of indigenous peoples' interactions, observations, and experiences with their ecological systems. Native knowledge is place-based and culture-based knowledge in which people learn to live in and adapt to their own environment through interactions, observations, and experiences with their ecological system. This knowledge is generally not solely gained, developed by, or retained by individuals, but is rather accumulated over successive generations, and is expressed through oral traditions, ceremonies, stories, dances, songs, art, and other means within a cultural context (USDA Forest Service 2012a). For the Kahler project, one objective of the prescribed fire treatments is to create or maintain suitable conditions on scabland environments for common camas, bitterroot, cous biscuitroot, and other First Foods species with traditional or cultural significance.

Native species. An organism that historically, or currently, is present in a particular ecosystem as a result of natural migratory or evolutionary processes; it is not present as a result of accidental or deliberate introduction into the ecosystem.

Natural fuel. Combustible material resulting from natural processes and not directly generated or altered by land management practices (Helms 1998). Compare with: *activity fuel*. Also see: *fuel*.

Natural regeneration. The renewal of a forest community by natural (as compared to human) means, such as tree seedling establishment from seed on-site, from adjacent areas, or seed brought in by wind currents, birds, or animals.

Nature. This term has been used to mean the natural world on Earth as it exists without human beings or civilization, that is, the environment including mountains, plains, rivers, lakes, oceans, air, and rocks, along with all other nonhuman, non-domesticated, living things (Botkin 1990a).

Noncommercial thinning. A treatment in immature forests designed to reduce tree density and thereby improve growth of the residual trees, enhance forest health, or anticipate future mortality resulting from intertree competition. Noncommercial (also known as precommercial) thinning involves situations where trees being cut are too small to be sold for conventional wood products, so they are typically left on site by either lopping them into pieces and scattering the pieces close to the ground, or aggregating them into piles that are later burned (Powell et al. 2001). For the Kahler project, noncommercial thinning is proposed for upland-forest sites, along some of the class IV RHCAs, and in shrub-steppe environments containing western juniper or ponderosa pine encroachment.

Old forest. A forest structural stage characterized by a predominance of large trees (> 21" dbh) in a stand with either one or multiple canopy layers. On warm dry sites that historically featured frequent, low-severity surface fires, a single stratum may be present containing 10 or more trees >21" dbh per acre (old forest single stratum; OFSS). On cool moist sites where surface fire was relatively uncommon, multi-layer stands with at least 10 (or 20 for sites with higher productivity) large trees (> 21" dbh) per acre in the uppermost stratum are typically found (old forest multi strata; OFMS). Compare with: *old growth*. For the Kahler project, silvicultural activities are proposed to convert some of the OFMS structural stage into the OFSS structural stage, which is historically more appropriate for dry-forest environments.

Old growth. Forest stands distinguished by old trees and related structural attributes such as tree size, accumulations of large dead woody material, number of canopy layers, species composition, and ecosystem function (Newton 2007). For national forest system lands in the Pacific Northwest, characteristics (attributes) of old-growth forests are described in USDA Forest Service (1993). Compare with: *old forest*.

Outbreak. A sudden increase in destructiveness or population level of a pest species in a given area; usually used in reference to bark beetles, defoliators, and other forest insects (Doliner and Borden 1984). For the Kahler project, existing vegetation conditions reflect the influence of historical outbreaks of mountain pine beetle in lodgepole pine (mid-1970s), western spruce budworm in mixed-conifer forests (1950s and 1980s), and Douglas-fir tussock moth in mixed-conifer forests (early 2000s most recently).

Overstory. For a stand of trees, overstory is the upper canopy layer; small trees established beneath the upper canopy layer are termed understory. Compare with: *understory; undergrowth*.

Pathogen. Any agent, whether a living organism or abiotic factor, that induces disease (Doliner and Borden 1984). For the Kahler planning area, the primary pathogens of concern include Armillaria and annosus root diseases in dry mixed-conifer forests (Schmitt and Spiegel 2010, 2012).

Physiognomy. The growth form and structure (habit) of vegetation in natural communities (Allaby 1998, Dunster and Dunster 1996). The characteristic feature or appearance of a plant community or vegetation (Winthers et al. 2005).

Physiognomic class. Taxonomic categories or hierarchical units based on vegetation of similar physiognomy or life form, such as the upland forest, upland shrub and riparian herb physiognomic classes. Physiognomic class is the highest level in the midscale portion of the Blue Mountains potential vegetation hierarchy (Powell et al. 2007). For the Kahler project, forest vegetation analyses pertain primarily to the upland forest physiognomic class, but some discussion also pertains to the upland woodland and upland shrub physiognomic classes.

Plant association. A plant community with similar physiognomy (form and structure) and floristics; commonly it is a climax community (Allaby 1998). It is believed that 1) the individual species in the association are, to some extent, adapted to each other; 2) the association is made up of species that have similar environmental requirements; and 3) the association has some degree of integration (Kimmins 1997). Also see: climax; seral stage: potential natural community.

Plant association group (PAG). Groupings of plant associations (and other potential vegetation types such as plant communities and plant community types) representing similar ecological environments, as defined by using temperature and moisture regimes (Powell et al. 2007). The most common PAG in the Dry Upland Forest PVG is the Warm Dry Upland Forest PAG.

Plant community. A naturally occurring assemblage of plant species living in a defined area or habitat (USDA Forest Service 2012a). In a vegetation classification context: (1) a plant community has no particular successional (seral) status; (2) plant communities represent vegetation types with a restricted geographical distribution; and (3) plant communities have such a small number of sample plots that it is not possible to infer their true successional status (Johnson and Clausnitzer 1992).

Plant community type. An aggregation of all plant communities with similar structure and floristic composition. A vegetation classification unit with no particular successional status implied (Dunster and Dunster 1996).

Plant succession. The process by which a series of different plant communities, along with associated animals and microbes, successively occupy and replace each other over time in a particular ecosystem or landscape location following a disturbance event (Kimmins 1997). The process of development (or redevelopment) of an ecosystem over time (Botkin 1990a).

Potential vegetation. The vegetation that would become established if successional sequences were completed without interference by man or natural disturbance under present climatic and edaphic conditions; the plant community developing if all successional sequences were completed under existing site conditions (Dunster and Dunster 1996). Also see: climax; seral stage: potential natural community.

Potential vegetation group (PVG). An aggregation of plant association groups (PAGs) with similar environmental regimes and dominant plant species. Each PVG includes PAGs representing a similar temperature or moisture influence (Powell et al. 2007). The focus of the Kahler Dry Forest Restoration Project is Dry Upland Forest, a PVG characterized by relatively warm or hot temperature conditions, and a dry or xeric moisture regime. For the Kahler project, potential vegetation groups (PVGs) are used as biophysical environments – most of the Kahler planning area (app. 87%) consists of the Dry Upland Forest biophysical environment (PVG).

Prescribed fire. Deliberate burning of wildland fuels in either a natural or modified state, and under specified environmental conditions, in order to confine the fire to a predetermined area, and to produce a fireline intensity and rate of spread meeting land management objectives (Powell et al. 2001). For the Kahler project, prescribed fire is an important management activity designed to manage tree-density levels (because prescribed fire mimics native surface fire, an important dry-forest thinning agent), maintain acceptable surface fuel loadings, and cycle ecosystem nutrients. For the Kahler project, three specific types of prescribed fire will be used to help manage both natural and activity fuels:

Jackpot burn. A method for burning activity-created fuels in which only the larger fuel concentrations are ignited, and the resulting fire is confined to these locations.

Pile burn. A method for burning activity-created fuels that were first piled by using mechanical equipment, or by hand, with an objective of reducing fuel loading to prescribed levels.

Underburn. Application of prescribed burning in activity-created or natural fuels located beneath a tree canopy, usually with an objective of ensuring survival of dominant, overstory trees.

Purpose and need statement. In a NEPA context, this is a brief statement specifying the underlying purpose of a project, and the need to which an agency is responding (40 CFR 1502.13). For the Kahler project, the purpose and need is focused on restoration of species composition, forest structure, and stand density conditions, all of which deviate substantially from historical (reference) conditions, in order to address issues and concerns related to insect and disease susceptibility (e.g., forest health), ecosystem integrity, and wildfire risk.

Range of variation. A characterization of fluctuations in ecosystem conditions or processes over time; an analytical technique used to define the bounds of ecosystem behavior that remain relatively consistent through time (Morgan et al. 1994). Values of composition, structure, density or another attribute, and falling between upper and lower bounds determined for the attribute (Jennings et al. 2003), are said to be within the range of variation. Attributes whose values occur above the upper bound are said to be 'over-represented;' attributes whose values are below the lower bound are said to be 'under-represented.' Also see: *reference conditions*. For the Kahler project, most of the forest vegetation desired conditions are characterized by using ranges of variation for species composition, forest structure, and stand density.

Reburn. The repeat burning of an area over which a fire has previously passed, but has left unburnt fuel (Helms 1998). For the Kahler project, reburn concerns focus on the portion of the 1996 Wheeler Point fire located in the planning area because young-forest stands there, which are classified as the stand initiation forest structural stage, are particularly vulnerable to another fire event due to small tree size.

Reference conditions. A reference ecosystem or reference conditions can serve as a model for planning ecosystem restoration activities. In its simplest form, the reference is an actual site, its written description (such as historical accounts of a reference area), or both (SERI 2004). Reference conditions also refer to a range of variation in ecological structures and processes, reflecting recent evolutionary history and the dynamic interplay of biotic and abiotic factors. Reference conditions generally reflect ecosystem properties that are free of major influence by Euro-American humans (Kaufmann et al. 1994). For the Kahler project, historical ranges of variation for species composition, forest structure, and stand density function as reference conditions in a forest vegetation context.

Reforestation. The restocking of an area with forest trees by either natural or artificial means, including out-planting of tree seedlings produced by a nursery. For the Kahler project, the primary focus of reforestation treatments is to modify species composition for some of the created gap areas in units receiving the variable-density thinning with skips and gaps activities, and to continue long-standing efforts to restore upland-forest environments within the 1996 Wheeler Point fire area.

Resilience. Intrinsic properties allowing the fundamental functions of an ecosystem to persist in the presence of disturbance; the 'bounce-back' capability of a system to recover from disturbance. "Ecological resilience is the capacity of an ecosystem to absorb disturbance and undergo change while maintaining its essential functions, structures, identity, and feedbacks. Resilience is often synonymous with adaptive capacity, i.e., the ability of a system to reconfigure itself in the face of disturbance or stresses without significant decreases in critical aspects such as productivity or composition" (Drever et al. 2006). Resilience recognizes that systems have a capacity to absorb disturbance, but this capacity has limits and when they are exceeded, the system may rapidly transition to a different state or developmental trajectory (Gunderson et al. 2010). In a climate-change context, resilience is sometimes viewed as analogous to adaptation. For the Kahler project, both near-term mitigation (resistance) and far-term adaptation (resilience) actions are planned, as described in the climate change section of this report.

Resistance. Resistance refers to the ability of an ecosystem to remain relatively unchanged in the face of external forces such as disturbance (pulse-type changes) or climate change. Resistance is sometimes viewed as being analogous to stability (Holling 1973), but in a climate-change context, it is often viewed as analogous to mitigation. For the Kahler project, both near-term mitigation (resistance) and far-term adaptation (resilience) actions are planned, as described in the climate change section of this report.

Restoration. Restoration involves holistic actions taken to modify an ecosystem to achieve desired, healthy, and functioning conditions and processes. This term is generally used to refer to the process of enabling a system to resume acting, or continuing to act, following disturbance as if disturbance had not occurred (Powell et al. 2001). Restoration is a process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on reestablishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystem sustainability, resilience, and health under current and future conditions (USDA Forest Service 2012a). Two restoration approaches have been described:

Active restoration. An approach involving implementation of active management practices (prescribed fire, thinning, etc.) to restore appropriate composition, structure, or density conditions. For the Kahler project, an active restoration paradigm is adopted – silvicultural activities are proposed to modify existing vegetation conditions and move them toward desired vegetation conditions.

Passive restoration. An approach involving removal of stressors causing ecosystem degradation, such as cessation of fire exclusion in fire-dependent ecosystems (Rapp 2002).

Riparian areas. Three-dimensional ecotones of interaction between terrestrial and aquatic ecosystems extending down into the groundwater, up above the canopy, outward across the floodplain, up nearby side-slopes draining to the water, laterally into the terrestrial ecosystem, and along the water course at variable widths (USDA Forest Service 2012a).

Riparian forest. A physiognomic class supporting a forest ecosystem, and occurring on riparian landforms or biophysical environments (Powell et al. 2007). See: *riparian areas*; *forest*. Compare with: *upland forest*.

Riparian management zone (riparian habitat conservation areas; RHCAs). Portions of a watershed where riparian-dependent resources receive primary emphasis, and for which plans include plan components to maintain or restore riparian functions and ecological functions (USDA Forest Service 2012a). For the Kahler project, some of the class IV RHCAs are proposed for treatment because these areas typically experienced a similar disturbance regime as adjoining non-RHCA ('upland') areas (Everett et al. 2003, Olson 2000), so they tend to have similar issues and concerns regarding composition, structure, or density not falling within their historical ranges of variation.

Risk. A combination of the likelihood that a negative outcome will occur (as related to susceptibility and vulnerability), and severity of the resulting negative consequences (USDA Forest Service 2012a). Note that risk refers to an event with a known occurrence probability, whereas uncertainty refers to an event with an unknown probability. For the Kahler planning area, the upland forest situation with the highest amount of perceived risk is potential for future uncharacteristic wildfire events, primarily because high-hazard conditions (overly dense stands with high crown-fire susceptibility) coincide with a highly vulnerable portion of the Heppner Ranger District, as evidenced by its recent wildfire activity (fig. 27).

Seral stage. Identifiable stages in the development of a sere, from an initial pioneer stage, through various early and mid-seral stages, to late seral, subclimax, and climax stages. The stages are identified by different plant communities, different ages of the dominant vegetation, and by different microclimatic, soil, and forest conditions (Kimmins 1997). Four seral stages are recognized (Hall et al. 1995):

Early Seral. Clear dominance of early-seral species (western larch, ponderosa pine, lodgepole pine, etc.) is evident; PNC species are absent or present in very low numbers.

Mid Seral. PNC species are increasing in the forest composition as they actively colonize the site (or as they continue an ongoing developmental process); PNC species are approaching equal proportions with early- and mid-seral species.

Late Seral. PNC species are now dominant, but long-lived early- and mid-seral species (ponderosa pine, western larch, etc.) may still persist in the plant community.

Potential Natural Community (PNC). The biotic community that one presumes would be established and maintained over time under present environmental conditions; early- and mid-seral species are scarce or absent in the plant composition.

Severity. Proportion of the organic matter lost from the vegetation and surface soils due to disturbances (Chapin et al. 2002).

Shade tolerance. The capacity of trees to grow satisfactorily in the shade of, and in competition with, other trees (Helms 1998). Also see: *tolerance*. For the Kahler planning area, the tree species with the greatest amount of shade tolerance are Douglas-fir and grand fir.

Shrub-steppe. Shrub-steppe ecosystems have been defined as plant "communities consisting of one or more layers of perennial grass above which there rises a conspicuous but discontinuous layer of shrubs" (Daubenmire 1970, p. 83). In the southeastern Washington and northeastern Oregon portions of the interior Columbia River basin, shrub-steppe plant communities often feature bitterbrush, big sagebrush, stiff sagebrush, or threetip sagebrush as primary shrub species, and bluebunch wheatgrass, Idaho fescue, basin wildrye, or Thurber's needlegrass as common grass species (Daubenmire 1970, Franklin and Dyrness 1973). For the Kahler project, shrub-steppe treatments are designed primarily to address encroachment of western juniper and ponderosa pine onto bitterbrush shrubland sites (fig. 3); treatments would reduce (but not eliminate) juniper and pine representation to historically appropriate levels.

Silvicultural prescription. A planned series of treatments designed to change current forest structure to one meeting the goals and objectives established for an area (Helms 1998). A prescription is a written statement or document defining the outcomes to be attained from silvicultural treatments; outcomes are generally expressed as acceptable ranges of the various indices being used to characterize forest development (Dunster and Dunster 1996). For the Kahler project, silvicultural activities (treatments), including prescribed fire, will be directed by silvicultural prescriptions, marking guides, and burn plans. Prescriptions will typically vary by silvicultural activity (including cutting method) and treatment unit.

Silvicultural treatment. An activity, practice, or action that can be applied in a controlled manner, according to the specifications of a silvicultural prescription or forest plan, to improve actual or potential conditions or benefits (Hoffman et al. 1999). For the Kahler project, the primary silvicultural treatments proposed for implementation include several types of commercial and noncommercial thinning, reforestation (tree and shrub planting), and prescribed fire.

Silviculture. Applying techniques or practices to manipulate forest vegetation by directing stand and tree development, and by creating or maintaining desired conditions. Silviculture is based on an ecosystem concept that emphasizes the need to evaluate the many abiotic and biotic factors influencing the choice and outcome of silvicultural treatments and their sequence over time, and the long-term consequences and sustainability of management regimes. [Definition derived from multiple sources.]

Skip. In forestry usage, skips include one or more portions of a stand, or a timber sale treatment unit, which are not to be entered during timber harvest activity. For the Kahler Dry Forest Restoration Project, skips are used in association with variable-density thinning to conserve particular microhabitat conditions, provide visual breaks or barriers, contribute to wildlife habitat connectivity corridors, or provide protective cover for down-wood concentrations or snag patches (Franklin et al. 2013). Compare with: *gap*.

Soil compaction. The process by which soil grains or particles are rearranged, resulting in a decrease in void space and causing closer contact with one another, thereby increasing bulk density (Helms 1998). For the Kahler project, design features and logging system considerations ensure that soil compaction will not reach detrimental levels on vulnerable sites or soil types (Archuleta 2014).

Species diversity. Number, evenness, and composition of species in an ecosystem; the total range of biological attributes of all species present in an ecosystem (Chapin et al. 2002).

Stewardship. Taking a long-term and integrated view of resource management – air, water, land, plants, and animals – recognizing the dependent relationships of humans on the environment, and that environmental health is fundamental to economic and human health (British Columbia Habitat Branch 2000).

Stewardship harvest. Often, stewardship involves a tree harvest operation completed for reasons other than production of timber commodities (Powell et al. 2001). Stewardship harvest also includes situations where the timber volume to be removed by a silvicultural treatment is insufficient to cover treatment costs (logging, transportation, etc.), so a subsidy payment must be made (e.g., cash contributed) to make the project financially viable.

Stressors. Factors that may directly or indirectly degrade or impair ecosystem composition, structure, or ecological process in a manner that may impair its ecological integrity, such as an invasive species, loss of connectivity, or the disruption of a natural disturbance regime (USDA Forest Service 2012a). For the Kahler project, it is anticipated that climate change will function as an important future stressor, and the silvicultural activities proposed for implementation appropriately account for this eventuality.

Structural stage. A stage or recognizable condition that relates to the physical orientation and arrangement of vegetation; the size and arrangement (both vertical and horizontal) of trees and tree parts. The following structural stages have been described (O'Hara et al. 1996, Oliver and Larson 1996):

Stand initiation. One canopy stratum of seedlings and saplings is present; grasses, forbs, and shrubs typically coexist with the trees.
Stem exclusion. One canopy stratum comprised mostly of pole-sized trees (5-8.9″ in diameter) is present. The canopy layer may be open (*stem exclusion open canopy*) on sites where moisture is limiting, or closed (*stem exclusion closed canopy*) on sites where light is a limiting resource.
Understory reinitiation. Two canopy strata are present the size class of the uppermost stratum is typically small trees (9-20.9″ in diameter). In this stage, a second tree layer is established under an older overstory. Overstory mortality created growing space for the establishment of understory trees.
Old forest. A predominance of large trees (> 21″ in diameter) is present in a stand with one or more canopy strata. On warm dry sites with frequent, low-intensity fires, a single stratum may be present (old forest single stratum; OFSS). On cool moist sites without recurring underburns, multi-layer stands with large trees in the uppermost stratum may be present (old forest multi strata; OFMS). For the Kahler project, silvicultural activities are proposed to convert some of the OFMS structural stage into the OFSS structural stage, which is historically more appropriate for dry-forest environments.

Surface fire. See: *fire*.

Susceptibility. This term refers to the probability of an organism being infected or infested by another organism (trees affected by bark beetles, defoliators, etc.), as evaluated by using inherent or intrinsic forest characteristics (species composition, stand density, etc.). The terms susceptibility and hazard are often used interchangeably. Compare with: *vulnerability*. For the Kahler planning area, a forest vegetation situation of management concern is high potential for future uncharacteristic wildfire events, due primarily to overly dense stands having high crown-fire susceptibility, because this situation occurs in a portion of the Heppner Ranger District with high levels of recent wildfire activity (fig. 27).

Sustainability. The capacity of forests, ranging from stands to ecoregions, to maintain their health, productivity, diversity, and overall integrity, in the long run, and in the context of human activity and use (Helms 1998). The capability to meet the needs of the present generation without compromising the ability of future generations to meet their needs (USDA Forest Service 2012a). For the Kahler project, silvicultural activities are designed to improve, and then maintain, the sustainability of forest vegetation resources, thereby fulfilling our important responsibility to act as a trustee of the Kahler environment for succeeding generations.

Sustainable forest management. Active "management that maintains and enhances the long-term health of forest ecosystems for the benefit of all living things while providing environmental, economic, social, and cultural opportunities for present and future generations" (Canadian Council of Forest Ministers 2008).

Thinning. A treatment designed to reduce tree density and thereby improve growth of the residual trees, enhance forest health, or recover potential mortality resulting from intertree competition. Two types of thinning are recognized – commercial thinning where the trees being removed are large enough to have economic value, and noncommercial thinning where trees are too small to be sold for conventional wood products, so the excess trees are cut and generally left on-site (Powell et al. 2001). For the Kahler project, several types of commercial and noncommercial thinning are proposed for implementation (table 1).

Timber harvest. The removal of trees for wood fiber use and other multiple-use purposes (USDA Forest Service 2012a). For the Kahler project, timber harvest is proposed for situations where tree removal would contribute to attainment of desired conditions, and the trees to be removed have sufficient economic value to support a stewardship or timber-sale contract approach.

Timber production. The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use (USDA Forest Service 2012a).

Tolerance. A forestry term expressing the relative ability of a plant (tree) to complete its life history, from seedling to adult, under the cover of a forest canopy and while experiencing competition with other plants (Harlow et al. 1996). In general ecology usage, tolerance refers to the capacity of an organism or biological process to subsist under a given set of environmental conditions. Note that the range of conditions under which an organism can subsist, representing its limits of tolerance, is termed its ecological amplitude (Helms 1998).

Traditional ecological knowledge. See: *native knowledge*.

Undergrowth. Herbaceous and shrubby plants growing beneath a forest canopy; as used in this report, undergrowth does not include small trees such as seedlings or saplings. Compare with: *understory*.

Understory. All of the vegetation growing under a forest overstory. In some applications, understory is only considered to be small trees (e.g., in a forest comprised of multiple canopy layers, the taller trees form the overstory, the shorter trees the understory); in other instances, understory is assumed to include herbaceous and shrubby plants in addition to trees. When understory is assumed to refer to trees only, other plants (herbs and shrubs) are often called an undergrowth to differentiate between the two (Helms 1998). Compare with: *undergrowth*.

Uneven-aged stand. A stand structure featuring trees of three or more distinct age classes (cohorts), occurring either as an intimate (intermingled) mixture or in small groups (Helms 1998). Reconstruction of historical stand structure for dry-forest sites suggests that these stands were typically uneven-aged, when evaluated at the stand level, but they tended to occur as assemblages of small, even-aged groups or clumps, with each group or clump generally occupying 0.6 acres or less (Powell 2014a).

Upland. Land that generally has a higher elevation than an adjacent alluvial plain, stream terrace, or riparian zone; or land above the foothill zone for a mountainous continuum (Dunster and Dunster 1996). For the Kahler project, most of the silvicultural activities are proposed for implementation on upland sites.

Upland forest. A physiognomic class supporting a forest ecosystem, and occurring on upland landforms or biophysical environments (Powell et al. 2007). See: *upland*; *forest*. Compare with: *riparian forest*. For the Kahler project, most of the silvicultural activities are proposed for implementation on upland-forest sites.

Variable density thinning (VDT). Variable-density thinning approaches are designed to emulate the natural variation resulting from small-scale canopy disturbances and competition-based tree mortality. VDT prescriptions often provide for unthinned areas (skips) and heavily-thinned patches (gaps), with intermediate levels of residual tree density prescribed for the remainder of the stand. This approach results in much greater spatial variability, structural complexity, and heterogeneity than is produced by typical intermediate stand treatments (Franklin et al. 2007).
For the Kahler project, most of the commercial thinning treatments (table 1) will be implemented as variable-density thinning with skips and gaps, although some of these thinnings will utilize the individuals, clumps, and openings (ICO) variant of VDT. In my opinion, the VDT and ICO approaches proposed for implementation in the Kahler project agree with dry-forest thinning recommendations offered by the conservation community (Brown 2002, Kerr 2007, Lillebo 2012).

Vulnerability. This term refers to the probability of tree or forest damage resulting from an infection or infestation by damaging agents (such as bark beetles, defoliators, etc.). Susceptibility reflects the influence of forest or stand conditions (are lodgepole pines in a stand larger than 9 inches in diameter, which renders them susceptible to bark-beetle attack?), whereas vulnerability relates to whether damage will actually occur (is a mountain pine beetle population in close proximity to a lodgepole pine forest containing susceptible trees?).
For the Kahler planning area, the upland forest situation with the highest amount of perceived risk is po-

tential for future uncharacteristic wildfire events, primarily because high-hazard conditions (overly dense stands with high crown-fire susceptibility) coincide with a highly vulnerable portion of the Heppner Ranger District, as evidenced by its recent wildfire activity (fig. 27).

Watershed. A region or land area drained by a single stream, river, or drainage network; a drainage basin (USDA Forest Service 2012a). The Kahler planning area consists of five contiguous and adjoining subwatersheds.

Wildfire. Any fire occurring on wildlands that is not meeting management objectives and thus merits a fire suppression response (Brenner 1998).

Wildland-urban interface. Areas where human communities are built in proximity to flammable fuels found in wildlands (Brenner 1998).

Wood decay. The decomposition of wood by fungi and other microorganisms, resulting in softening, progressive loss of strength and weight, and often changes in texture and color (Helms 1998). Terms associated with wood decay are provided below (unless noted otherwise, term definitions provided by the USDA Forest Service, Forest Products Laboratory).

Bluestain. A deep-seated fungal discoloration, predominantly bluish in color but sometimes grey, black or brown, confined mostly to the sapwood. Bluestain does not cause a loss of structural strength (Doliner and Borden 1984).

Brown rot. In wood, any decay in which the fungal attack concentrates on the cellulose and associated carbohydrates rather than on the lignin, which produces a light to dark brown friable residue known variously as ‘dry rot’ or ‘cubical rot’.

Heart rot. Any rot or decay characteristically confined to the heartwood portion of a tree. Heart rot generally originates in the living tree (such as rust-red stringy rot caused by the Indian paint fungus).

Incipient decay. An early stage of tree decay that has not proceeded far enough to soften or otherwise perceptibly impair the hardness of wood. It is usually accompanied by a slight discoloration or bleaching of wood tissue.

White rot. In wood, any decay or rot attacking both the cellulose and the lignin, producing a generally whitish residue that may be spongy or stringy rot, or occur as pocket rot (advanced decay appearing in the form of a hole or pocket). White rot tends to produce more complete decomposition of the wood, and its decay products are much shorter lived (in the soil) than decay products produced by brown rots.

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Appendix O
Range Report

Contents

KAHLER DRY FOREST RESTORATION PROJECT RANGE REPORT

Tim Collins

February 2015

SCALE OF ANALYSIS

The scale of the Kahler Restoration Project (KRP) for this range report is at the Hydrologic Unit Code (HUC) 10 scale (Kahler Creek-Johnday River). Approximately 32,647 acres of the project area are public lands managed by the Umatilla National Forest. There are approximately 197,773 acres within the HUC 10 watershed boundary. Roughly 16.5 percent of the watershed is publicly owned and managed by the Umatilla National Forest.

Table 1 HUC 10 Watershed Boundary

HUC_10	HU_10_NAME	National Forest Acres	Total Acrage
1707020401	Kahler Creek-John Day River	32,647	197,773

Portions of grazing allotments on the Umatilla National Forest that are within the KPR are; Stone Hill, Tamarack, Monument, Collins Butte, Yellowjacket and Hardman Allotments. For the purpose of discussing domestic livestock grazing, all of the area located within the allotments will be included in the KRP analysis area.

METHODOLOGY AND ASSUMPTIONS

Mitigation measures described in Appendix A will be part of this analysis. In discussing the existing conditions of the grazing allotment within the analysis area, two habitat types will be discussed: Uplands and Riparian Areas.

Uplands have historically been rated based on permanent upland monitoring points known as Condition and Trend Clusters. Condition and Trend Clusters were established during the 1950's and 1960's within the analysis area. These monitoring points have not been analyzed recently on these allotments and are not currently scheduled to be monitored again in the short term. As a result, the Allotment Management Plans, Annual Operating Instructions, and professional judgment will be used to discuss the existing condition of uplands within the analysis area.

Environmental consequences of this project on livestock grazing will be discussed in relation to how each alternative affects management of livestock in uplands and riparian habitat types. Distribution of livestock will be discussed in terms of these two habitat types.

EXISTING CONDITIONS

General History of Grazing

Historical information suggests that domestic livestock grazing in Eastern Oregon occurred prior to European settlement. Cayuse Indians kept horses in their camps as early as the mid-1700's, which most likely had effects on vegetation. Once early settlers started using the Oregon Trail and settlement started in the west domestic livestock (horses, cattle and sheep) numbers increased substantially. The earliest recorded domestic livestock grazing within the analysis area was 1915. Prior to use records, domestic livestock grazing within the analysis area was season long and unregulated. Season long grazing and poor range management practices left riparian areas and open rangelands generally in poor condition. From the late 1920's through the late 1940's, allotments were identified, boundaries were fenced, term grazing permits were issued to local ranchers and regulated by Forest Rangers, and stocking rates were continually reduced. By the late 1940's, stocking rates had decreased. During the 1950's and 1960's, pasture division fences were constructed and rotational grazing strategies were implemented to defer and rotate pastures and improve upland and riparian condition. By the mid 1970's, upland range conditions were improving and many areas were in fair to good range condition.

In the 1980's to present, riparian/exclosures have been constructed to address riparian grazing management. In the 1990's, to present major streams were riparian corridor fenced to exclude livestock from fish bearing streams.

The Umatilla National Forest has a long history with livestock grazing. One of the most significant changes in livestock grazing on the Umatilla National Forest, like other National Forests, has been a steady decrease in the numbers and kind of livestock allowed on the forests.

Livestock numbers on the Umatilla National Forest peeked in the 1890's to early 1900's in the hundreds of thousands of sheep and cattle. As the Forest Reserves became established, grazing became a managed and regulated activity on the Umatilla National Forest. By the late 1930's, permitted livestock grazing on the Umatilla National Forest had been reduced to 88,102 sheep and 8,582 cattle (Powell, 2008). Sheep grazing was reduced on the Umatilla National Forest over several decades and began to level off in the 1960'. Sheep allotments were often converted to cattle allotments. From the 1960's to present time, the numbers of cattle authorized were slowly reduced. By 1990, 10,000 cattle and 8,000 sheep were authorized on the forest. As of 2014, the Umatilla National Forest authorizes 8,453 cattle and 5,750 sheep on 28 cattle allotments and 4 sheep allotments.

Another significant change on the Umatilla National Forest has been where grazing is authorized. Livestock grazing occurred across most of the forest until the 1930's through the 1950's. During this time period, many sheep allotments were becoming vacant mostly due to market changes in the livestock industry. Other allotments were closed over time due for various reasons including conflicts with ESA listed species, encroaching forest stands, and conflicts with other resources. In 1990, the Umatilla National Forest grazed 77% of the 1.4 million acres on the forest (UNF LRMP, 1990). The Umatilla National Forest now only grazes approximately 52% of the 1.4 million acre forest. Over 70% of all grazing on the Umatilla National Forest now occurs on the south half of the forest primarily in the North Fork John Day River Watershed.

Current Management

Within the KRP there are seven active allotments that are grazed annually, Table 2. There are approximately 32,647 acres with the Kahler Restoration Project Area. The total area of the project is approximately 2.3% of the Umatilla National Forest (1.4 Million Acres).

Stone Hill Allotment (Vacant)

The Stone Hill Allotment is a vacant allotment that is surrounded by BLM managed land and private property. There are approximately 252 acres that are national forest system lands that are within the Stone Hill Allotment that are within the analysis area.

Winlock Cattle Allotment

The Winlock Cattle Allotment is approximately 5,194 acres and is divided into two pastures or units: East Winlock and West Winlock pastures. 134 cow/calf pairs are permitted on the allotment for approximately 62 days during a grazing season from May 15th through July 15th.[1] Livestock are currently permitted during early season use to promote upland use before the hot season to reduce grazing in and near riparian areas. An environmental analysis was completed on this allotment in 2008 and the Allotment Management Plan was implemented in 2009.

Yellow Jacket Cattle Allotment

The Yellow Jacket Cattle Allotment is approximately 7,647 acres and is not divided into pastures or units. 115 cow/calf pairs are permitted on the allotment for approximately 122 days during a grazing season from June 1st through September 30th.

Collins Butte Cattle Allotment

The Collins Butte Cattle Allotment is approximately 16,916 acres and is divided into four pastures or units: Dixon Basin, Mahogany, Flat Iron and Long Meadows. 277 cow/calf pairs are permitted on the allotment for approximately 137 days during a grazing season from June 1st through October 15th.

Hardman Cattle Allotment

The Hardman Cattle Allotment is approximately 21,572 acres and is divided into eight pastures or units: East Wildcat, East Wilson, West Wilson, West Wildcat, Grassy Butte, Wall Creek Riparian Pasture, South Whitetail and North Whitetail. 322 cow/calf pairs are permitted on the allotment for approximately 122 days during a grazing season from June 1st through September 30th

Tamarack Cattle Allotment

The Tamarack Cattle Allotment is approximately 19,441acres and is divided into three pastures or units: Little Tamarack, Stalling and Wildhorse pastures. 209 cow/calf pairs are permitted on the allotment for approximately 122 days during a grazing season from May 15th through September 15th.

Monument Cattle Allotment

The Monument Cattle Allotment is approximately 18,585 acres and is divided into five pastures or units: Indian Creek, Cold Springs, Rail Canyon, Thorne Butte and HappyJack pastures. 292 cow/calf pairs are permitted on the allotment for approximately 122 days during a grazing season from May 15th through September 15th.

All allotments are managed using various range management techniques, numbers of livestock turned out, salting, water developments and timing of use, are currently used to meet riparian and upland goals. Riparian objectives include maintaining and/or increasing the bank stability and shade along streams and upland objectives include fair to good range condition and static to upward trends *(Forest Plan.)* A grazing system using specific distribution techniques is used to maintain water quality and protect riparian vegetation. Improvements also have been located to encourage livestock use away from streamside vegetation and increase distribution on the uplands.

CONDITIONS

Uplands

In general, range vegetation within the Kahler Project Area includes open pine, juniper and bunch grass stands, wet and dry meadow types, open Sandberg's bluegrass and one-spike oatgrass plant communities, and transitory rangeland consisting of fir/mixed conifer timber types. Many areas of transitory rangeland were created since the 1930's by timber harvest and seeded to nonnative species such as orchard grass and fescues. These areas improved the amount of forage available for livestock grazing and helped improve livestock distribution. Transitory rangeland has been decreasing in available forage and accessibility as tree canopy has increased. Stocking rates have decreased since the 1920's. Water developments such as ponds and spring developments have been constructed on the allotments to improve distribution and reduce the concentration of livestock during the grazing season. Fences have been constructed on each allotment to improve distribution and management of cattle while on the allotment. Different grazing strategies are used (differed or rest rotation of pastures) to improve range condition within these allotments.

Riparian

Since the mid 1990's to present may miles of riparian areas have been fenced to control the use of livestock riparian areas. In general, the current livestock management has improved stream channel characteristics by narrowing stream channels, stabilized streambanks. Vegetation on streambanks has also improved as well as shrubs in and along riparian areas.

Kahler Project and the Allotments Associated with the Project

Table 2 Allotments within the Kahler Project Area

Allotments Within the Project Area	Acres of Allotment Within Kahler	Allotment Acres	Permitted Season	Permitted Livestock Numbers
Stone Hill	252	252	Vacant	252
Winlock	5,194	5,194	05/01-07/15	134
Collins Butte	9,531	16,916	06/01-10/15	277
Yellow Jacket	877	7,647	06/01-09/30	115
Monument	5,723	18,585	05/15-09/15	292
Tamarack	10,441	19,441	05/15-09/15	209
Hardman	63	21,572	06/01-09/30	322

RANGE IMPROVEMENTS

Fences and Fenceline Right-A- Ways, Water Developments (Ponds and Springs/Troughs), Cattle Guards, and Gates

Range improvements are used to manage livestock that are within and outside of the Kahler Planning Area. Range improvements are necessary to meet management objectives and requirements related to the Umatilla Land and Resource Management Plan (range goals and objectives) and ESA consultation requirements. Activities/treatments that are planned as part of this analysis should take into account the protection of all range improvements within and outside of the Kahler Planning Area. Annual fence maintenance/upkeep is required to maintain functionality of fences. This includes but is not limited to right-a-way clearing, fence alignment, falling snags that will damage fences or block right-a-way along fences. Pond and spring maintenance includes but is not limited to cleaning debris and excess silt from pond areas. Maintenance of ponds include but is not limited to spillway/overflow cleaning and reconstruction; dam reconstruct. Maintenance of spring/trough developments may include but is not limited to; spring box replacement; pipe replacement (trenching-digging up spring box) and replacing box/piping and piping components to trough area and trough overflow. Fencing/protecting spring area may be needed to keep domestic and wild animals out of spring area.

Future removal of existing ponds within stream channel areas to improve stream conditions may involve developing new improvements such drilling wells, developing upland spring sources, developing solar pump/gravity flow systems from stream channel areas to provide off channel water for domestic livestock watering needs.

Cattle-guard(s)/gate(s) placement may a necessary to where road bisect allotment division, riparian and boundary fences within the planning area. Areas were motorized vehicles are allowed may be gated or a cattle-guard may be installed where the public have trouble consistently keeping gates closed to manage livestock within pastures and allotments within the planning area.

ENVIRONMENTAL CONSEQUENCES

Effects Common to All Alternatives

Direct, and Indirect effects:

Livestock grazing would continue to occur within the analysis area with current stocking levels and management technique to improve resource conditions. Management techniques include but are not limited to; maintaining range improvements, herding livestock, salting and mineral placement, and using portable corral systems to load and unload livestock within the planning area. Maintenance of existing range improvements and management techniques that benefit resource conditions and reduce grazing effects to riparian and upland areas are allowed under this analysis.

Effects Unique to No Action

Direct and Indirect effects:

Livestock grazing distribution on the uplands and riparian areas would stay the same or continue to decrease as stocking in timber stands grows denser and wood continues to accumulate on the ground. Livestock access would stay the same or continue to decrease due to down wood, continuous small regeneration, and visibility. Forage would also stay the same or continue to decrease due to the reduction of sunlight on the forest floor reducing forest floor vegetation.

Cumulative effects:

The no action alternative would continue the buildup and decay of dead and down material that could potentially result in large wildfire activity. The buildup of dead and down material, increased stems per acre could result in the reduction of available forage for domestic livestock and decrease the amount of forage available for wild and domestic ungulates. The continued increase in un-even aged timber stands would continue to move area away from historic land conditions.

Effects Common to Action Alternatives

Direct and Indirect effects:

Action alternatives are intended to modify the upland-forest stands to a species composition and structure compatible with the historical range of variability. These alternatives identify several management treatments that vary in degrees of intensity and duration to improve conditions that will benefit forage and improve access for livestock within the project area. The identified treatments and the connected actions planned identified for the Kahler planning area will improve vegetation conditions across the landscape. The planned treatments will reduce the amount of canopy cover, and competition for light and nutrients that are favorable for understory plant associations. The identified management treatments will also improve the distribution, access and management of livestock in the project area making it easier for the permittees to locate and move livestock.

Proposed harvest, commercial thinning, precommercial thinning, fuels treatments, and burning (upland and riparian) could reduce the effectiveness of fences (which are used as a tool to manage livestock in portions of the allotment at specific times). However, the identified mitigation under all the proposed action would protect fences in their existing condition to prevent unplanned livestock movement between pastures. Precommercial thinning has caused concern and injury to horses (saddle and pack horses) that the permittees use on the allotments to manage livestock. Injury is caused by small trees that are cut with a chainsaw at an angle leaving sharp stubs that are left sticking out of the ground that animals (saddle horses/pack animals) may step on.

The obliteration and decommissioning of existing roads in the project area will affect the permittees management of livestock on the allotment. The permittee use existing road systems to manage livestock on the allotments. The permittees also use the existing road systems for accessing range improvements (fences, ponds, springs) annually to maintain these structures to manage livestock.

Prescribe fire treatments that are planned in and around the Kahler planning area will be beneficial to vegetation that is grazed/browed by wild and domestic ungulates. Reducing canopy cover and removing ground fuels will improve resource conditions by increasing forage quantity and forage quality. Livestock management in relation to large landscape type fires (wildfires and prescribe fires) has the potential to reduce the number of days and/or livestock numbers grazed in areas that have burned. Moving/ herding livestock, reducing livestock numbers and days livestock graze burned areas are acceptable management techniques that may allow recovery of vegetation and soils within a burned area. Coordination/communication with the permittee(s) prior to burning an area (prescribed fire) where livestock are grazing or will be grazing during the season is necessary. Protection of structural range improvements (fences, ponds and springs) from fire damage is critical to managing livestock operations. Constructing additional fences (upland and riparian) and developing upland water away from riparian areas may be necessary to improve livestock distribution/management within the Kahler planning area.

Cumulative effects:

The purposed treatments to the forested vegetation will restore tree stocking levels to historic stocking levels by reducing uneven aged timber stands. Proposed treatments will improve forage for livestock and create better management of pastures within the allotments. With the abundance of available forage and the improved management of livestock there could be an increase carrying capacity within allotments. Increases in livestock numbers and grazing season may be justifiable. Improving the distribution of livestock will most likely be followed up with the need for additional water developments and fencing projects to continue to improve the pastures/allotments within the project area. Some of the past, present and future activities/projects that have occurred or are currently occurring within the project area include but are not limited to; livestock grazing, commercial/non-commercial thinning, wildfires, prescribed fires, fire control, noxious weed treatments, road development/removal, fence construction/ water development for livestock management, motorized/non-motorized recreation, tree/shrub planting, grass seeding, rodent and disease control, etc. Many of these activities/projects overlap in time and in space. Maintaining or improving the distribution of quality habitat by restoring the landscape to historical levels will benefit the landscape and protect the long-term viability of the project area. Mitigation measures, Best Management Practices (BMP's) standards and guides are used to reduce long term cumulative effects.

_/s/ Tim Collins__________	_2/2015____
Tim Collins	DATE
Range Management Specialist	

APPENDIX A: MITIGATION MEASURES

1. All existing structural range improvements (fences, fence right-a-ways, gates, developed water sources, cattle guards) will be protected contractually during project implementation..
2. Fences which are cut in order to facilitate logging/fuel treatment operations must be repaired to Forest Service specifications.
3. If livestock are present on either side of a fence, means will be taken to prevent the movement of livestock to the other pasture in accordance with the annual grazing plans. If no livestock are present, gates and fences shall be operable prior planned livestock entry.
4. It will be a contract requirement that all gates will remain closed during work and nonwork hours while cattle are in the project area.
5. Fence right of ways and stock driveways and trails will be cleared of slash produced by comercial/non-commercial activities.
6. Snags that will fall or have fallen on structural improvements such as; fences, fence rightaways, water developements (ponds and springs), gates, cattle guards, trails, will be cut and cleared/piled in the immediate area of the improvement.

REFERENCES

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