Modeling Existing and Future Vegetation Characteristics, Wildlife Habitat and Fire Behavior Indices in the Kings River Project Area under Three Management Scenarios

August 9, 2006

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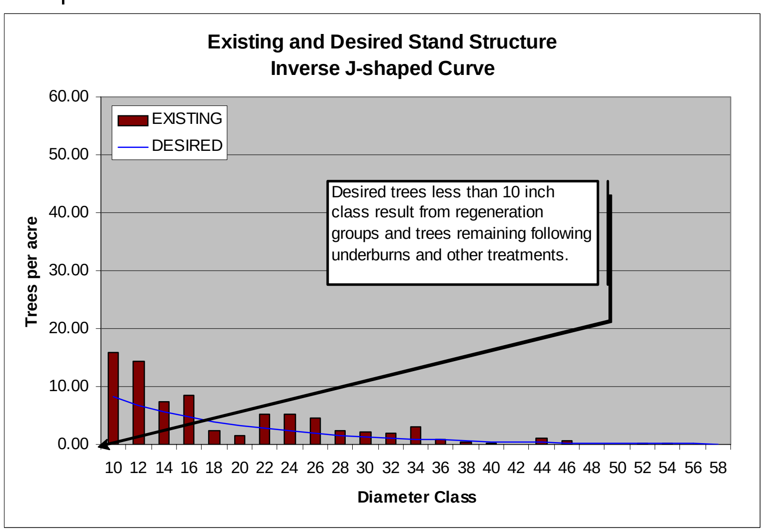
INTRODUCTION

Background

The High Sierra Ranger District on the Sierra National Forest (NF), in cooperation with the Pacific Southwest Research Station (PSW), is proposing to implement the Kings River Project (KRP), which is intended to restore pre-1850 conditions across the landscape. The Kings River Project began in 1994 as an administrative study implemented by the NF and PSW. The KRP uses alternative methods of forest management suggested by Verner et al. (1992) to preserve the viability of the California spotted owl and other species while maintaining long term productivity. The goals of this project are to reduce the potential for catastrophic wildfire and insect damage, ensure the regeneration of shade intolerant tree species (i.e. black oak, ponderosa pine) and provide opportunities for scientific study of the changes induced by the treatments (Peckinpaw et al. 2005). The proposed project is designed to minimize the risks to threatened, endangered and sensitive species while applying uneven-aged and prescribed fire treatments.

To achieve the goals of restoring the landscape to pre-1850 conditions, the Sierra NF proposes altering stand structure and species composition by means of silvicultural treatments and prescribed fire (Rojas 2004). An uneven-aged management strategy will be utilized as the primary silvicultural treatment. The objective of uneven-aged management is for treated areas to exhibit a tree size distribution frequency as shown in figure 1, where there are declining numbers of trees with increasing diameter class size. The resulting curve is called a reverse J-shaped curve, and is defined by the diminution quotient (Dq), residual basal area and the diameter of the largest tree. The Dq is a value that, when divided into the number of trees in one size class, results in the number of trees in the next larger size class. The residual basal area defines the amount of growing stock to be carried through time and has the effect of raising or lowering the height of the J-curve. The length of time to grow the largest tree also determines the shape of the J-curve.

Figure 1. Desired trees per acre by two inch diameter class using a Dq of 1.2. The resulting curve is described as J-shaped.



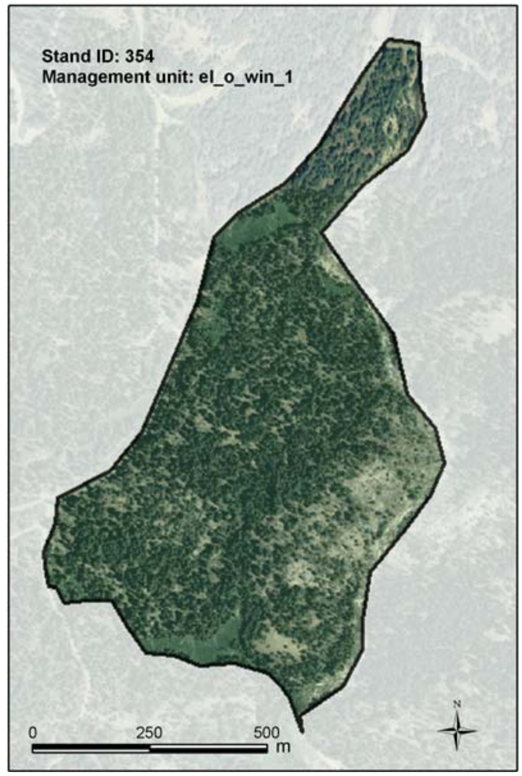
Purpose

The Sierra NF is writing an environmental impact statement so that the effects of the proposed action can be described to the public and decision makers. In an effort to predict changes in forest structure, composition, wildlife habitat and fire behavior, we chose to utilize forest growth models. This modeling was performed so that Forest Service personnel can assess direct effects, indirect effects and cumulative effects to habitat for all terrestrial species. The results of this model will also be used to assess changes in stand structure and fire behavior across the landscape due to the proposed action and other alternatives.

Three scenarios, which are described later in this document, were modeled in an effort to compare the different alternatives:

1. Preferred alternative
2. Reduced harvest tree size (30") alternative
3. No action alternative

Figure 2. A display of the heterogeneous vegetation on a typical stand in the Sierra NF



The modeling was preformed at a fine-scale to provide the interdisciplinary team, researchers and the public with a more realistic sense of the complexity of forest structure that exists in the KRP area (figure 2). The use of growth models, while maintaining the spatial component, was done to display the potential changes in habitat, vegetation structure and fire behavior across the landscape.

Spatial and Geographic Hierarchy

The KRP is approximately 29 miles northeast of Fresno, California. The proposed projects and study are to occur within the Big Creek and Dinkey Creek watersheds on the Sierra National Forest (Figure 3), which are approximately 131,500 acres in size. Within the two watersheds, but not spanning the entire watersheds, are 79 management units (figure 3), which have a total area of 71,895 acres (average area of 910 acres each). These 79 management units are dominated by conifers and are most amenable to uneven-aged management. Appendix A shows a complete list of the 79 management units.

Each management unit is composed of multiple stands; there are a total of 797 stands in the KRP. A stand is defined as an area undergoing the same management strategy and fuels treatment. Each management unit has an average of ten stands, averaging about 90 acres each; each stand is assigned a management strategy (Appendix B). See figure 4a for an example of a management unit and its associated stands. The stands are further divided into simulation units, which are polygons of homogeneous vegetation that are being treated (silviculture and fuels) in the same manner (figure 4b).

In short, each stand has its own management strategy and fuels treatment (Appendix B). The stands are intersected with a GIS layer depicting vegetation, resulting in a layer depicting the simulation units. Simulation units have homogeneous vegetation and receive the same silviculture and fuels treatment. The spatial and geographic unit that gets modeled is the simulation unit; each simulation unit is modeled separately. There are 11,793 simulation units in the study area with an average area of 6.1 acres. Appendix E describes the methods employed to create the simulation units.

Figure 3. Map depicting the 79 management units within the Big Creek and Dinkey Creek watersheds.

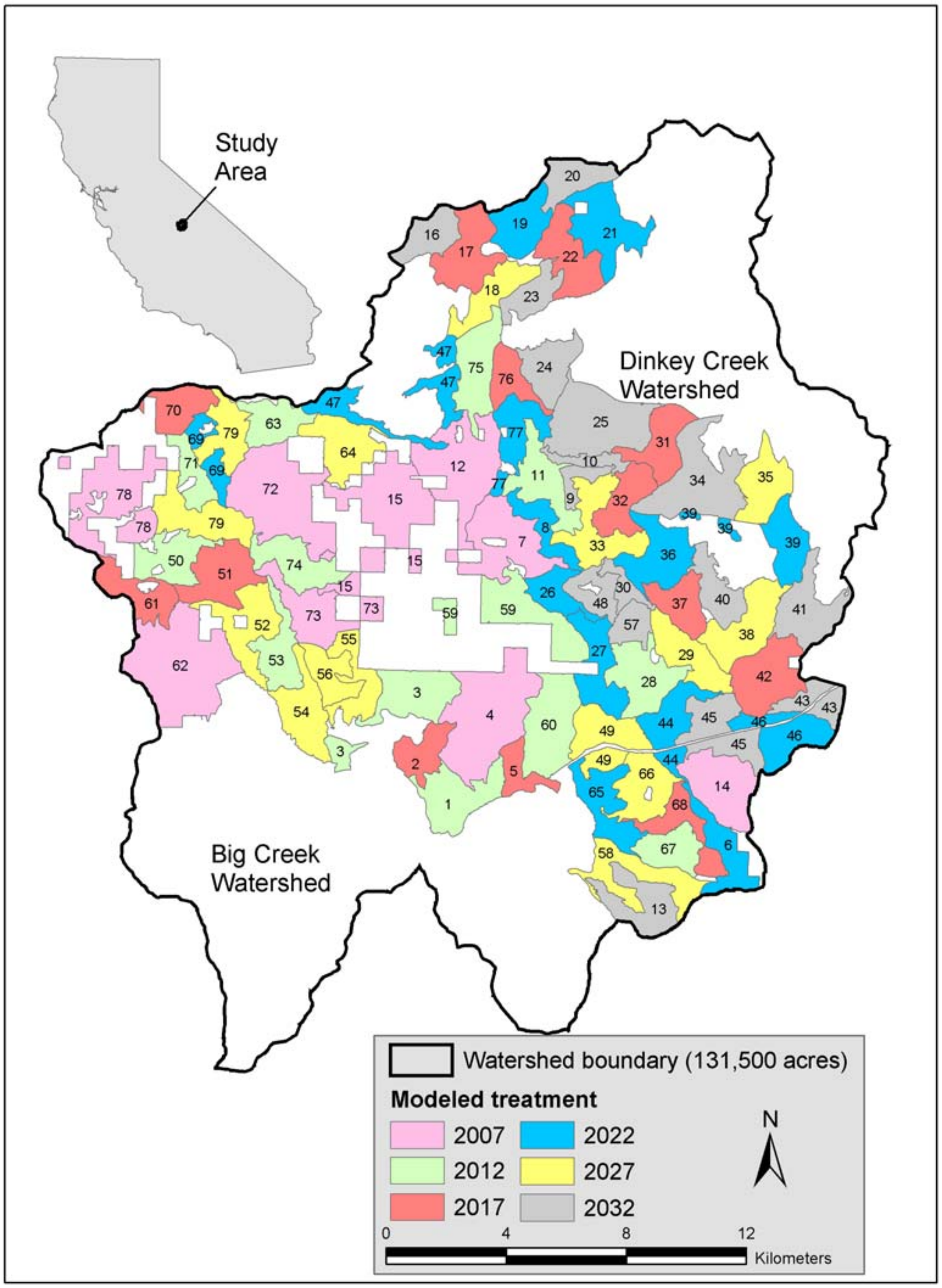
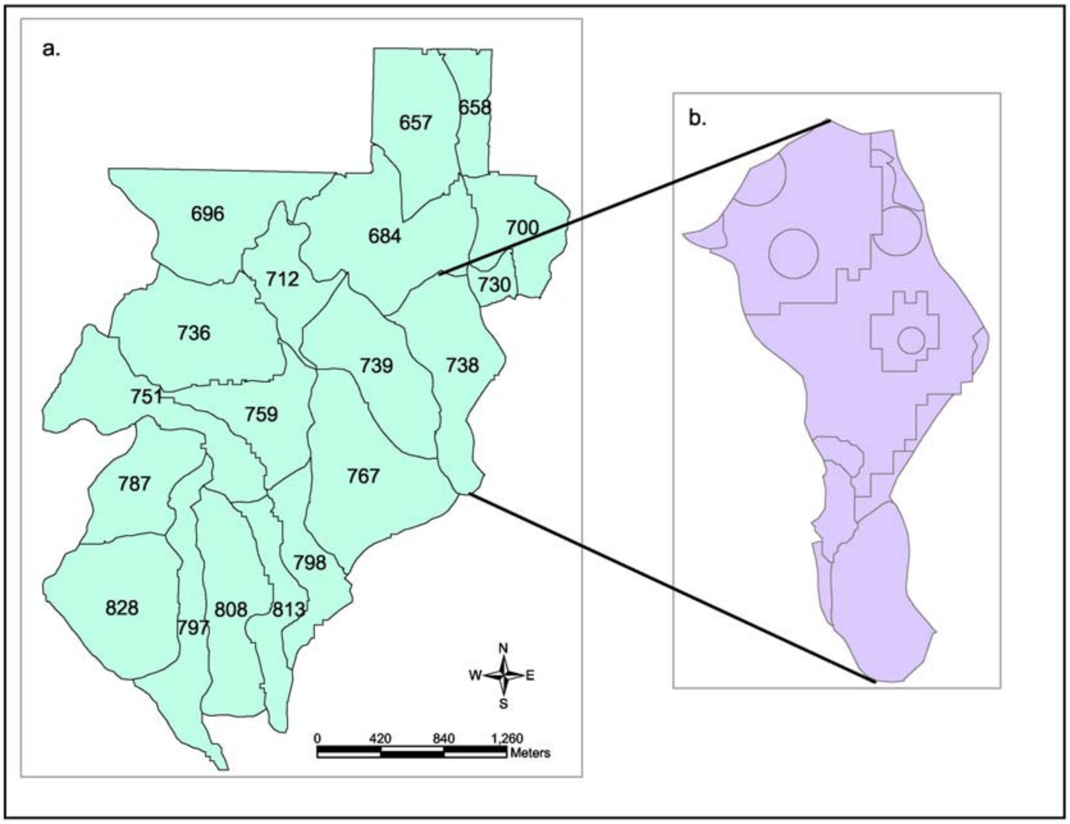


Figure 4a. Depiction of the bear_fen_6 management unit and its associated stands. Stand IDs correspond to the table in Appendix B.

Figure 4b. Depiction of the simulation units in stand 738 in the bear_fen_6 management unit.



METHODS

Overview

Modeling the future vegetation conditions of the KRP involved many steps, including GIS data preparation/manipulation (including the delineation of regeneration gap polygons), plot data preparation/organization, imputing plot data to simulation units with no vegetation plots, and modeling vegetation change over time with the Forest Vegetation Simulator (Sage 1973). The subsections below briefly describe each of these steps. In steps where the details are beyond the scope of the main document, appendices at the end of the document will provide further detail.

GIS data preparation/manipulation – Delineating Simulation Units

As mentioned previously, the simulation unit is the geographic unit that gets modeled and is composed of homogeneous vegetation that receives the same silvicultural and fuels treatment. Homogeneous vegetation is defined by polygons in a GIS layer provided by the Sierra National Forest. Two general steps are involved in the creation of simulation units: delineating regeneration gap areas and "intersecting" the appropriate GIS layers.

For stands that are to be treated mechanically using the uneven-aged management strategy, 10% of the area in those stands is designated as regeneration gap areas. Regeneration gaps are designed to provide openings to regenerate shade intolerant species (such as ponderosa pine and black oak) and provide space for young trees that define the reverse J-shaped curve. At the time this vegetation modeling project was initiated, there was no knowledge of where the regeneration gaps were to be placed on the landscape. However, there are some basic rules that the silviculturist will follow when placing regeneration gaps, making it possible to model the locations of these regeneration gaps. A custom script was created in ArcView GIS (ESRI Inc. 2000) to model the location, shape and size of the regeneration gaps. Due to the stochastic nature of the model and parameters implemented to simplify the model, the spatial location, size and shape of these regeneration gaps are most likely error-prone, but the total area of the regeneration gaps and vegetation types in which these regeneration areas are placed should be correct. For further details concerning the steps involved in creating the regeneration gaps, consult Appendix E.

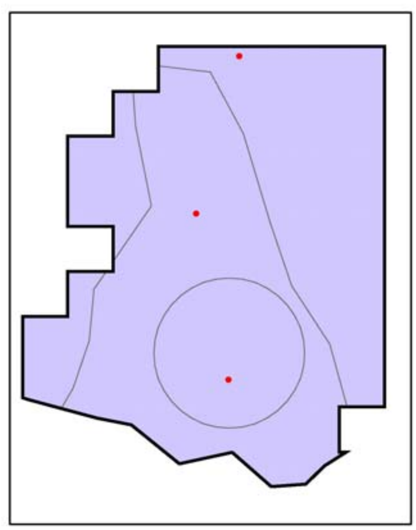
Once the regeneration gaps were delineated, GIS layers depicting vegetation, regeneration gaps, California spotted owl buffers and old forest linkages were intersected using GIS, resulting in a GIS layer illustrating the simulation units (Appendix E).

Plot Data Preparation/Organization – Creating a Spatially Explicit Relationship

The vegetation plot data were not originally assigned to the individual simulation units or vegetation polygons, but were instead assigned to the larger stands in which they were collected. The simulation units were created long after the plot data were collected. Because one of the goals of this modeling project is to model the landscape at a scale finer than the stand (to reflect the KRP landscape heterogeneity), building a spatial link between the simulation units and the plot data was essential.

Oftentimes a vegetation polygon, which is generally an area of homogeneous vegetation type and structure, was dissected into one or more simulation units. We wished to preserve and utilize the plot data within the vegetation polygon into which it originally fell even though the vegetation polygon was subdivided into two or more simulation units. To achieve this goal, the plot data from a particular vegetation polygon was assigned to all simulation units created from that original vegetation polygon. Figure 5 helps illustrate this concept, which depicts a single vegetation polygon (outlined in thick black). This vegetation polygon has three plots and was dissected into multiple simulation units (thin black lines). We assigned the plot data from all three plots to each of the five simulation units that compose the vegetation polygon in figure 5. We created an *Avenue* script in ArcView GIS (ESRI Inc. 2000) to complete this data manipulation task.

Figure 5. Illustration of an individual vegetation polygon, and its associated simulation units and vegetation plots.

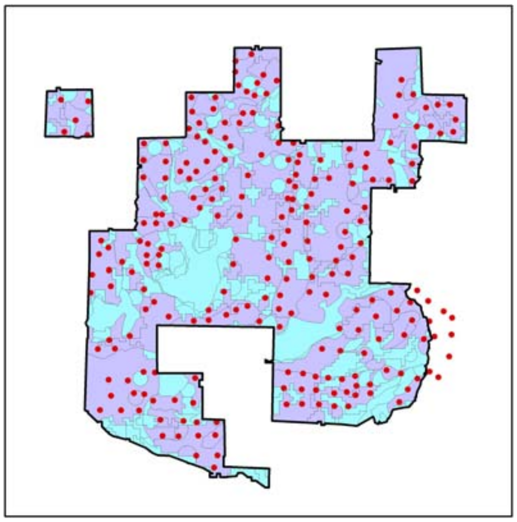


Imputing Plot Data to Uninventoried Simulation Units – Most Similar Neighbor

The Forest Vegetation Simulator uses vegetation plot data to project vegetation into the future. A vegetation plot is defined as a geographic location in which information on the size and type of trees is collected on the ground by field crews. The type of vegetation plot utilized for this project is a stand exam, which is a variable-radius vegetation plot with nested fixed plots.

Although data were collected on a large number of vegetation plots (n = 1,967), every simulation unit does not contain vegetation plot information (figure 6). In order to use FVS to model all simulation units, it is necessary to assign representative plot data to uninventoried simulation units. To carry out this task, a program named Most Similar Neighbor (MSN) (Crookston et al. 2002) was utilized.

Figure 6. Purple simulation units contain plot data, while the light blue ones do not, and are considered uninventoried simulation units. MSN outputs which inventoried simulation unit is "most similar" to each uninventoried simulation unit.



MSN is a statistical program that uses canonical correlation analysis to utilize relationships between the plot-based vegetation variables and GIS-based variables. There are plot-based vegetation variables only in simulation units where vegetation plots were placed, and there are GIS-based variables for the entire project area, making it possible for MSN to use the relationship to impute the plot-based vegetation data to uninventoried simulation units. The MSN program outputs which inventoried simulation units are "most similar" to the uninventoried simulation units. We created an *Avenue* script in ArcView GIS (ESRI Inc. 2000) to automate the assignment of plot data to uninventoried simulation units. For detailed methods on how MSN was implemented, see Appendix F.

As mentioned earlier, there are 1,967 vegetation plots. A small number of plots were excluded because there had been a fire or a management action on the plot since the data was collected. Also, a few plots were excluded because of obvious errors in vegetation data or plot location. The final number of plots utilized in this analysis is 1,910.

Modeling with the Forest Vegetation Simulator

A program known as the Forest Vegetation Simulator (FVS) (Sage 1973) is utilized to project the vegetation into the future. This program is widely used and accepted within and outside of the Forest Service. FVS, originally referred to as Prognosis, was first developed in 1973 and is an individual-tree, distance-independent growth and yield model. FVS can simulate a wide range of silvicultural and fuels treatments. Variants of FVS provide growth and yield models for specific geographic areas; we used the variant designed for the western slope of the Sierra Nevada Mountains. The USDA Forest Service is constantly upgrading existing variants and developing additional variants.

Three scenarios were modeled across the KRP landscape. For all scenarios, simulations begin in 2007 and continue through 2057 and are analyzed and reported in five-year increments. Each of the three scenarios is simulated with and without a severe fire in 2015. Executing the scenarios with and without a severe fire gives Forest Service personnel and others a means of comparing changes in potential fire behavior due to the silvicultural and fuels treatments. The severe fires are simulated using the Fire and Fuels Extension to FVS (FFE-FVS) (Reinhardt and Crookston 2003), and the details are addressed in Appendix D. The three scenarios are as follow:

1. Preferred alternative: This alternative is described in further detail in the proceeding sections and in the appendices. This is hereafter referred to as either the "preferred alternative" or the "proposed action".
2. Reduced harvest tree size (30") alternative: This alternative accounts for recommendations made in the Sierra Nevada Forest Plan Amendment, Final Supplemental Environmental Impact Statement, Record of Decision (2004). This alternative is very similar to the preferred alternative, but accounts for maximum diameter limit recommendations. This alternative is described in further detail in the proceeding sections and in the appendices.
3. No action alternative: This alternative simply models growth of trees with no silvicultural or fuels treatment.

In an effort to manage and understand the complexity of the three modeled alternatives, we are introducing some terminology. The silvicultural details are arranged hierarchically in this section and in our analysis. First, there are three "alternatives": the proposed action, reduced harvest tree size and no action. "Alternatives" are defined as different paradigms in managing the KRP landscape. Within each alternative, there may be multiple "management strategies". A "management strategy" is defined as a major silvicultural paradigm in this analysis and the KRP. Each of the 797 stands is assigned one of the four management strategies for the preferred and reduced harvest tree size alternatives (figure 7; Appendix B). Within each of these management strategies, there are one or more discrete "prescriptions" (figure 7). A "prescription", in our analysis, is defined as a general silvicultural treatment type. And within each prescription, there may be multiple "specific treatments." The "specific treatments" differ from prescriptions because they are usually triggered by conditional statements (certain conditions must be met within the simulation unit). There may be multiple prescriptions and multiple specific treatments within each management strategy in order to attain particular goals or because of constraints within the stand (California spotted owl activity center or old forest linkage). Figure 8 shows the management strategies, prescriptions and specific treatments for the proposed action alternative.

As is apparent in Appendix A and B, all of the silvicultural treatments do not occur across the entire landscape at one moment in time; they are spaced out through time starting in 2007 and ending in 2032. Although a large proportion of the landscape will be treated under the preferred and reduced harvest tree size alternatives, the treatments are spread out, both spatially and temporally, in an effort to minimize risks to the California spotted owl, fisher and other species.

Figure 7. This figure illustrates how each stand is assigned a management strategy in the proposed action alternative. Note that under each management strategy, there are one or more prescriptions. The underburn only management strategy is not shown here because no stands are assigned this strategy in the providen_1 management unit.

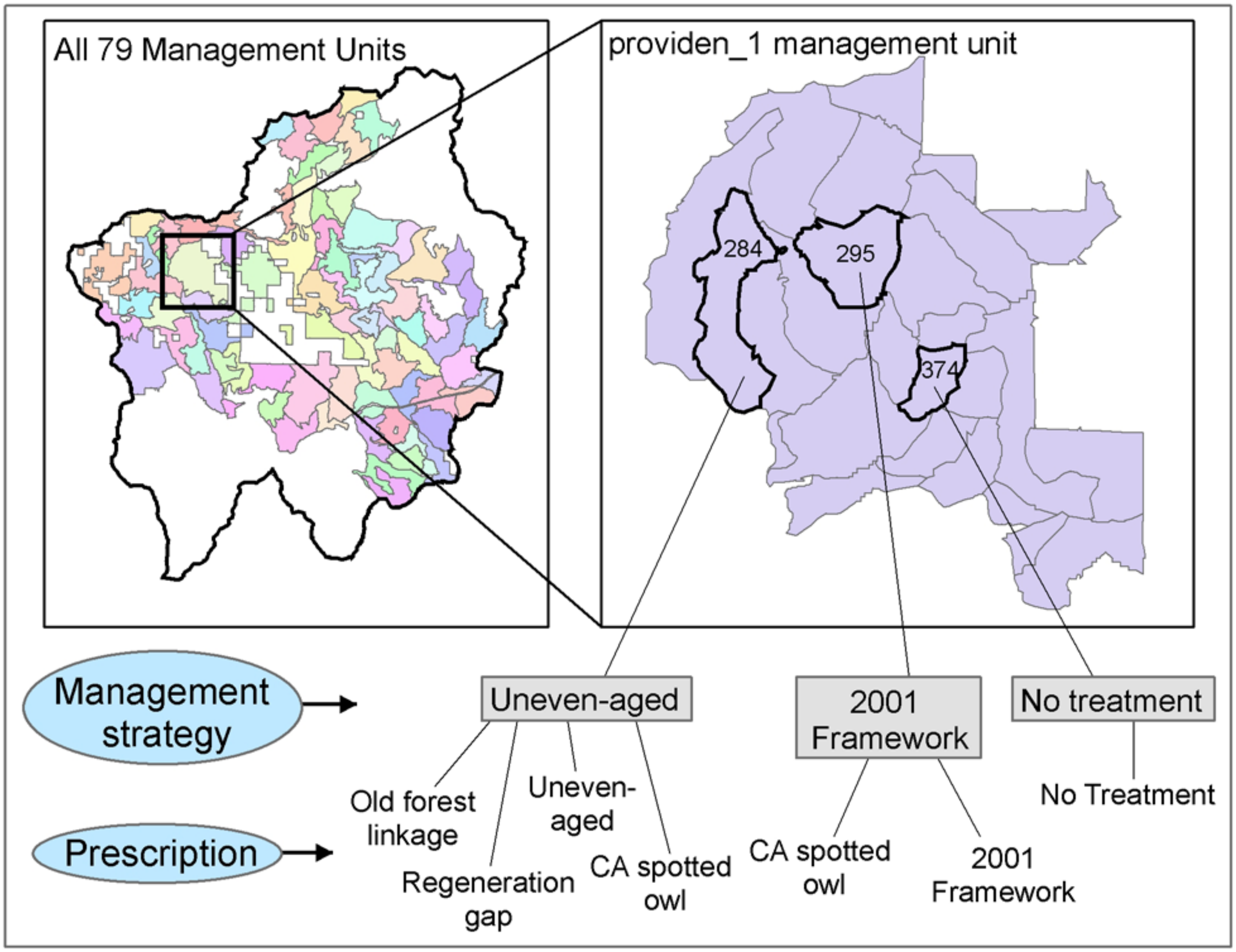
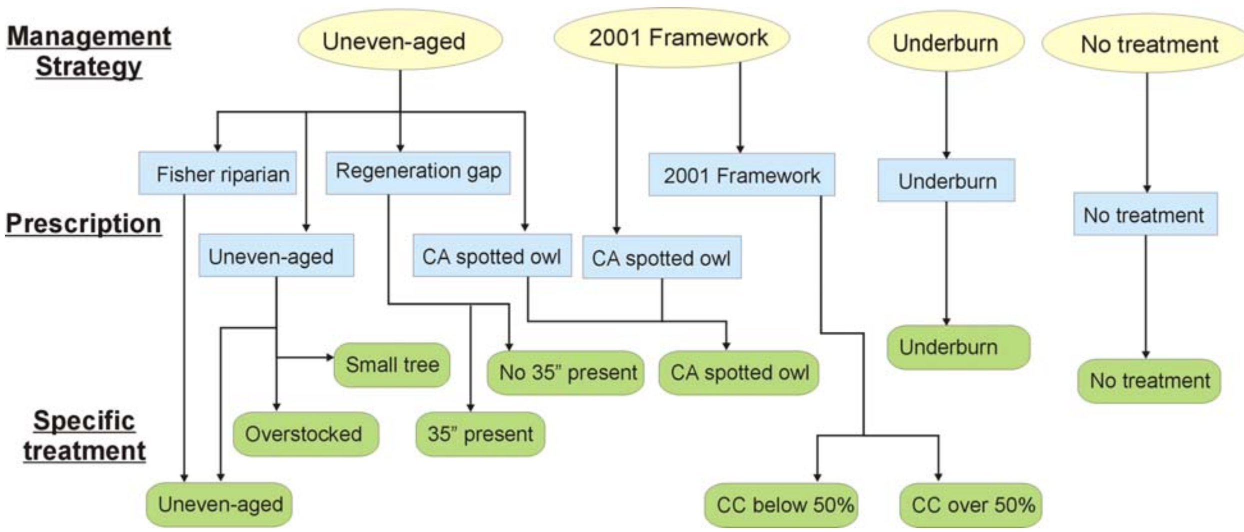


Figure 8. Organization chart showing the complexity of the proposed action.



<u>Proposed Action Alternative</u>

Below is a description of the methods implemented and of the management strategies, prescriptions and specific treatments in the proposed action. The proposed action alternative is composed of four management strategies: the uneven-aged, underburn only, 2001 framework (thinning from below) and no treatment.

<u>Uneven-aged management strategy</u>

The uneven-aged strategy is the dominant management strategy in the project area, occurring on 611 stands (out of 797). The goal of this management strategy is to restore the landscape to pre-1850 conditions, which will reduce the potential for catastrophic wildfire and insect damage, ensure the regeneration of shade-intolerant species, such as ponderosa pine, and preserve the viability of the California spotted owl and other species. Within the uneven-aged management strategy, there are four silvicultural prescriptions: uneven-aged, regeneration gap, old forest linkage and California spotted owl.

Uneven-aged prescription:

Within the uneven-aged prescription, there are three specific treatments: uneven-aged, overstocked and small tree. Only one of the three specific treatments is executed in the model depending upon the vegetation conditions. The uneven-aged specific treatment is executed based on stand conditions, while the overstocked and small tree specific treatments are executed based on simulation unit conditions.

Uneven-aged specific treatment: In this specific treatment, each stand is assigned a basal area target (BAT), as designated in Appendix B. The basal area target is the desired/expected residual basal area of the stand after treatment. The BAT was determined based on the desired canopy cover of the stand and the dominant tree type (ponderosa pine, red fir, etc.). Because we know the distribution of the reverse J-shaped curve, we know the BAT for each two-inch diameter class. For example, consider a stand with a BAT of 200 ft^2/acre. We know that the desired basal area (BA) in the 17.0 – 18.9" diameter class is 10.8 ft^2/acre.

The uneven-aged specific treatment is quite complex because the desired silvicultural outputs are on the stand scale, but the model is executed at a finer scale (the simulation unit). As a reminder, a stand is composed of many simulation units. To manage the disparity between the stand-based objectives and the simulation unit-based modeling, an extension to FVS was utilized, called the Parallel Processor Extension (PPE) (Crookston and Stage 1991). The PPE, in conjunction with FVS, will conditionally select simulation units for treatment based on stand parameters.

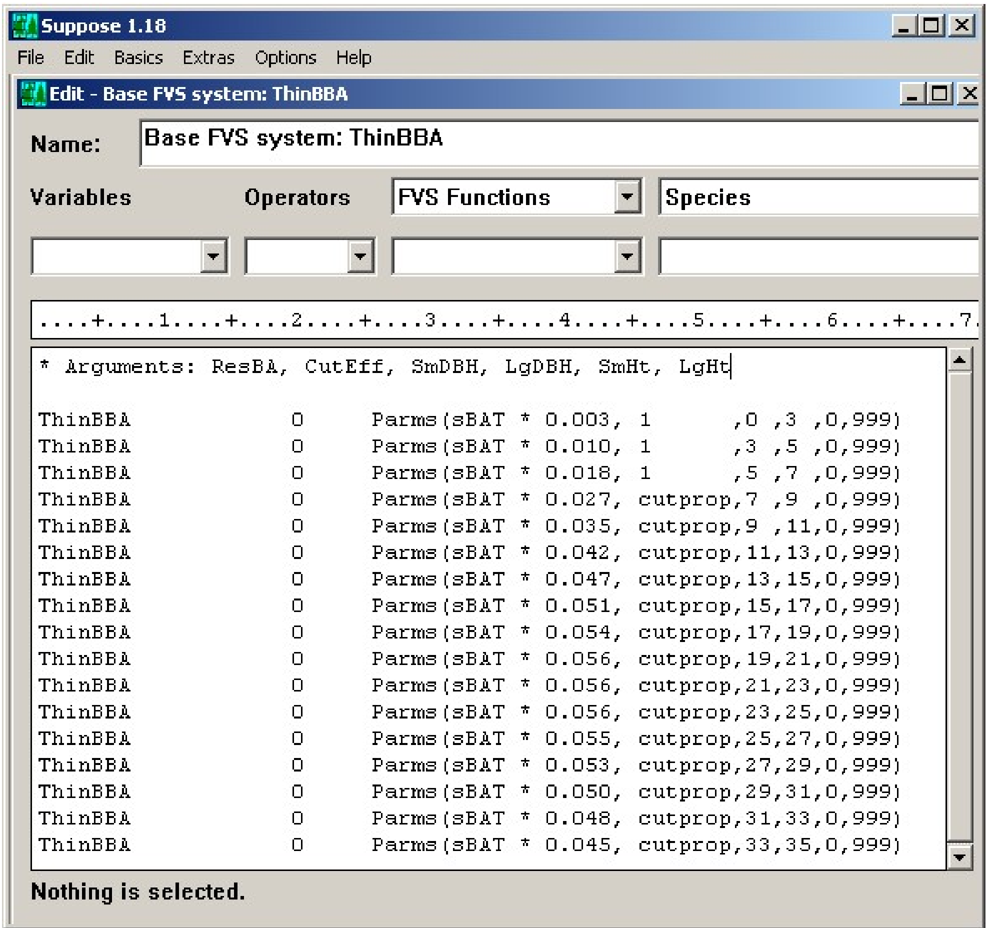
As an example of how the PPE works, let us consider a stand with a basal area target of 200 ft^2/acre. We would not want FVS to cut each simulation unit to a basal area (BA) of 200 ft^2/acre, because some simulation units have a BA below 200 ft^2/acre before treatment. If all simulation units were cut to 200 ft^2/acre, and some were below 200 ft^2/acre before treatment, then the stand would average below 200 ft^2/acre after treatment, which is not the desired result. The PPE will ensure that individual simulation units are treated until the stand-based desired output (in this case a BAT of 200 ft^2/acre) is reached, and then no more simulation units within the stand are selected for the uneven-aged specific treatment.

If the PPE determines that a particular simulation unit needs to be treated in order to reach the stand objectives, then FVS will only cut in the diameter classes where there are excesses. This means that only the diameter classes where there is more basal area than is expected will be treated. Within FVS, the actual treatment type is a thin from below to a BA target (figure 9). Again, to continue with our example of a BAT of 200 ft^2/acre, FVS will thin from below in the 0 to 2.9" diameter class to a BA of 0.6 ft^2/acre, thin from below in the 3.0 to 4.9" diameter class to a BA of 2.0 ft^2/acre, thin from below in the 5.0 to 6.9" diameter class to a BA of 3.6 ft^2/acre, etc. For those simulation units selected by the PPE, figure 9 shows the exact treatment as designed and executed in FVS.

Overstocked specific treatment: Simulation units that were not selected by the PPE, but are considered overstocked, receive a specific treatment that is slightly different. For our purpose, an overstocked simulation unit is defined as having a stand density index (SDI) of greater than 60% of its maximum. Overstocked simulation units will be treated in a similar manner as simulation units undergoing the uneven-aged specific treatment.

Small tree specific treatment: For simulation units that are not considered overstocked (the SDI is less than or equal to 60% of its maximum) and are not selected by the PPE for the uneven-aged specific treatment, some small trees are removed.

Figure 9. Shows the uneven-aged specific treatment within FVS. "sBAT" refers to the basal area target (Appendix B) and "cutprop" refers to the cutting efficiency (see Appendix C).



Regeneration Gap Prescription:

In the uneven-aged management strategy, regeneration gaps are designed provide openings to regenerate shade intolerant species (such as ponderosa pine and black oak) and provide young trees the desired stand structure defined by the inverse J-shaped curve. The regeneration areas compose 10% of the area of each stand. Within the regeneration gap prescription, there are two specific treatments: 35" present and no 35" present. No regeneration gaps are placed within 500 feet of a known California spotted owl activity center or in the old forest linkages. Details of how regeneration gaps were delineated on the landscape are specified in Appendix E.

35" present specific treatment: In the initial treatment year designated in Appendix B, this treatment cuts all trees below 35" dbh and leaves all trees above 35" dbh.

No 35" present specific treatment: If, however, there are no trees above 35" dbh, all trees below 24" dbh will be cut, and a maximum of four trees per acre of trees greater than 24" dbh will be left.

For both specific treatments within the regeneration gap prescription, a thin from below leaving 190 trees per acre below 24” dbh is modeled ten years after the initial treatment. After the initial treatment, if more than 30% of the basal area was removed and the simulation unit is below 6000 feet elevation, the model simulated the planting of 176 ponderosa pine, 70 sugar pine and 91 white fir per acre. If the simulation unit is above 6000 feet elevation and more than 30% of the basal area was removed, the model simulated the planting of 136 Jeffrey pine, 50 white fir and 91 red fir per acre. An additional 25 incense cedar per acre are naturally established every ten years for all simulation units below 6000 feet elevation.

Old Forest Linkage Prescription:

Old forest linkages were set up near rivers and streams to aid fishers in movement and dispersal. This prescription is almost exactly that of the uneven-aged specific treatment. However, the basal area target is not the value listed in Appendix B, but is either 207 or 267 ft^2/acre depending on the relative density of the fir (red and white) component in the simulation unit.

California Spotted Owl Prescription:

If there is a California spotted owl activity center within a particular stand, then all areas within a 500 foot radius are treated differently. This is a simple prescription, and involves the removal of 75% of the basal area in all trees 6” dbh and less.

<u>Underburn Management Strategy</u>

The underburn management strategy consists of three separate underburns. The underburns are modeled three, seven and fifteen years after the year specified in Appendix B. No silvicultural treatments occur in this management strategy. For each underburn, the model parameters are as follow:

a. 1-hour fuels (0 – 0.25”): 7% moisture content
b. 10-hour fuels (0.25” – 1”): 8% moisture content
c. 100-hour fuels (1 – 3”): 10% moisture content
d. 1000-hour fuels (3”+): 100% moisture content
e. Duff: 125% moisture content
f. Live woody fuels: 150% moisture content
g. Live herb fuels: 150% moisture content
h. Temperature: 70º Fahrenheit
i. Wind speed: 5 mph
j. Percentage of stand area burned: 70%

<u>2001 Framework Management Strategy (Thinning From Below)</u>

This set of prescriptions is a best-attempt to mimic the management strategy described in the 2001 framework record of decision (USDA Forest Service 2001). The 2001 framework strategy (thinning from below) is modeled on 38 stands. This management strategy occurs within California spotted owl protected activity centers that are part of the California spotted owl study. In the 2001 Framework management strategy (thinning from below), there are two silvicultural prescriptions: 2001 Framework and California spotted owl.

2001 Framework Prescription:
Within the 2001 Framework prescription, there are two specific treatments: CC over 50% and CC below 50%.

CC over 50% specific treatment: If the average canopy cover of the stand exceeds 50%, then simulation units in the stand with more than 50% canopy cover are thinned from below (only trees less than 20” dbh) to a residual canopy cover of 50%. The parallel processing extension was again utilized for this prescription: simulation units are only treated until the stand canopy cover reaches 50%.

CC below 50% specific treatment: If the average canopy cover in the stand is less than 50%, or if any individual simulation unit has a canopy cover of less than 50%, then the simulation units are thinned from below to a residual of 250 trees per acres (TPA) in the 0 – 6” dbh range (no trees above 6” dbh are cut).

California Spotted Owl Prescription:
If there is a California spotted owl activity center within a particular stand, then all areas within a 500 foot radius are treated differently. This is a simple prescription, and involves the removal of 75% of the basal area in all trees 6” dbh and less.

<u>No Treatment Management Strategy</u>
Under this management strategy, we simply use FVS model natural growth with no silvicultural treatment. Appendix B lists the 114 stands that receive the no treatment management strategy.

<u>**Reduced Harvest Tree Size (30”) Alternative**</u>
The reduced harvest tree size alternative was created to account for diameter limit recommendations made in the Sierra Nevada Forest Plan Amendment, Final Supplemental Environmental Impact Statement, Record of Decision (USDA Forest Service 2004). The reduced harvest tree size alternative is composed of the modified uneven-aged, underburn, 2001 Framework (thinning from below) and no treatment management strategies. Within these management strategies, there are multiple prescriptions and specific treatments, which are described below. This alternative is very similar to the proposed alternative, so these descriptions are less detailed than the proposed alternative.

<u>Modified uneven-aged strategy</u>
The uneven-aged strategy is the dominant management strategy for the reduced harvest tree size alternative, occurring on 611 stands. The goal of this management strategy is to restore the landscape to pre-1850 conditions, which will reduce the potential for catastrophic wildfire and insect damage, ensure the regeneration of shade-intolerant species, such as ponderosa pine, and preserve the viability of the California spotted owl and other species. Within the modified uneven-aged management strategy, there are four silvicultural prescriptions: modified uneven-aged, modified regeneration gap, modified old forest linkage and California spotted owl.

Modified Uneven-aged prescription:

Within the modified uneven-aged prescription, there are three specific treatments: modified uneven-aged, modified overstocked and small tree. Only one of the three specific treatments is executed in the model depending upon the vegetation conditions. The modified uneven-aged specific treatment is executed based on stand conditions, while the modified overstocked and small tree specific treatments are executed based on simulation unit conditions. In the modified uneven-aged prescription, simulation units are treated in the initial treatment year shown in Appendix B and are again treated in the same manner 30 years later.

Modified uneven-aged specific treatment: This specific treatment is exactly the same as that described in the proposed alternative, with one difference: no trees over 30” are cut. Refer to the description of the uneven-aged specific treatment in the proposed action for details.

Modified overstocked specific treatment: This specific treatment is exactly the same as that described in the proposed alternative, with one difference: no trees over 30” are cut. Refer to the description of the overstocked specific treatment in the proposed action for details.

Small tree specific treatment: This specific treatment is exactly the same as that described in the proposed alternative.

Modified Regeneration Gap Prescription:

In the uneven-aged management strategy, regeneration gaps are designed provide openings to regenerate shade intolerant species (such as ponderosa pine and black oak) and provide young trees the desired stand structure defined by the inverse J-shaped curve. The regeneration areas compose 10% of the area of each stand. Within the regeneration gap prescription, there are two specific treatments: 30” present and no 30” present. No regeneration gaps are placed within 500 feet of a known California spotted owl activity center or in old forest linkages. Details of how regeneration gaps were delineated on the landscape are specified in Appendix E.

30” present specific treatment: In the initial treatment year designated in Appendix B, this treatment cuts all trees below 30” dbh and leaves all trees above 30” dbh.

No 30” present specific treatment: If, however, there are no trees above 30” dbh, all trees below 24” dbh will be cut, and a maximum of four trees per acre of trees greater than 24” dbh will be left.

Details about all regeneration gap specific treatments: This is exactly the same as that described in the proposed alternative.

Modified Old Forest Linkage Prescription:

Old forest linkages were set up near rivers and streams to aid fishers in movement and dispersal. These areas have a separate prescription, which is very similar to that of the modified uneven-aged specific treatment. The only difference is that the basal area target is not the value listed in Appendix B, but is either 207 or 267 ft^2/acre depending on the relative density of the fir (red and white) component in the simulation unit.

California Spotted Owl Prescription:

If there is a California spotted owl activity center within a particular stand, then all areas within a 500 foot radius are treated differently. This is a simple prescription, and involves the removal of 75% of the basal area in all trees 6" dbh and less.

Underburn Only Management Strategy

As shown in Appendix B, there are 34 stands that undergo the underburn only management strategy. This management strategy is exactly as that of the proposed action alternative.

2001 Framework Management Strategy (Thinning From Below)

The 2001 management strategy (thinning from below) and its associated prescriptions and specific treatments is exactly as that of the proposed action alternative.

No Treatment Management Strategy

Under this management strategy, we simply use FVS model natural growth with no silvicultural treatment.

No Action Alternative

Under the no action alternative, we simply use FVS model the natural growth of all simulation units with no silvicultural or fuels treatments.

Fuels Treatments – Proposed Action and Reduced Harvest Tree Size (30") Alternatives

There are four treatments that were modeled using FVS-FFE in an attempt to closely mimic the proposed fuels treatments: pile burn, underburn, gross yard and no fuels treatment. Each of the 797 stands is assigned a fuels treatment (Appendix B), and the fuels treatments are assigned independent of management strategy. There is no difference in the fuels treatments between the proposed action and reduced harvest tree size alternatives. More types of fuel treatments are proposed, but they are lumped into these four categories for modeling purposes.

Pile Burn

The pile burn fuels treatment is modeled on 345 stands. Within these 345 stands, only simulation units that undergo any silviculture treatment receive the pile burn fuels treatment.

We used the default values for the pile burn fuels treatment: 70% of the area is affected by treatment, 10% is the affected area where fuel is concentrated, 80% is the proportion of fuel that is collected in the affected area and 0% is the mortality.

Underburn

The underburn fuels treatment gets modeled in 298 stands. The underburn fuels treatment consists of three separate underburns after the initial silvicultural treatment. The underburns are modeled three, seven and fifteen years after the initial treatment. All simulation units in these stands receive the underburn treatment.

For each underburn, the model parameters are as follow:

a. 1-hour fuels (0 – 0.25"): 7% moisture content
b. 10-hour fuels (0.25" – 1"): 8% moisture content
c. 100-hour fuels (1 – 3"): 10% moisture content

d. 1000-hour fuels (3”+): 100% moisture content
e. Duff: 125% moisture content
f. Live woody fuels: 150% moisture content
g. Live herb fuels: 150% moisture content
h. Temperature: 70º Fahrenheit
i. Wind speed: 5 mph
j. Percentage of stand area burned: 70%

Gross Yard

The gross yard fuels treatment is very similar to the pile burn fuels treatment and is modeled on 40 stands. Only simulation units that undergo silvicultural treatments receive the gross yard fuels treatment.

The gross yard fuels treatment simply has different values for the parameters used in the pile burn treatment. The area affected by the gross yard treatment is 100%, the affected area where fuel is concentrated is 1%, the proportion of fuel that is collected in the affected area is 90% and the mortality is 0%.

No Fuels Treatment

Fuels are not treated in 114 of the stands. Of these 114 stands, 104 receive no fuels treatment because they receive no silvicultural treatment (controls).

Fire-Related Modeling

The Fire and Fuels Extension to FVS (FFE-FVS) (Reinhardt and Crookston 2003) is a model that simulates fuel dynamics and potential fire behavior over time (Beukema et al. 2003). We used the FFE-FVS for the following operations:

1) Generate information about potential fire fuel conditions
2) Simulate a severe wildfire for each scenario
3) Simulate fuels treatments
4) Specify fuel model under certain conditions

Fire reports were generated for both a potential moderate and potential severe fire. The output variables (Appendix G) in these reports are useful to determine severity of fire threat among the different scenarios. Because the output from this model maintains the spatial component, some of the output variables from the potential fire reports, such as crown bulk density and canopy base height, will be utilized in the FARSITE (Finney 1998) or FlamMap (Finney In Press) landscape fire models. Further details of how the FFE-FVS was utilized are described in Appendix D.

The FFE-FVS was also utilized to simulate a severe wildfire. Simulation of the severe wildfire was carried out in order to compare how fire behavior indices varied between the alternatives. We realize that it is not likely that the entire KRP landscape will burn during one fire event, but the results of this simulation serve as an index of resistance to severe fires. The severe fire was simulated in 2015, and the parameters input into FFE-FVS are detailed in Appendix D.

CWHR Crosswalk

The California Wildlife Habitat Relationships (CWHR) (Mayer and Laudenslayer 1988; California Department of Fish and Game 2002) system contains habitat relationship information on 675 species of amphibians, reptiles, birds, and mammals that reside in the California. This system provides a method for assessing the habitat suitability for these 675 wildlife species, including the California spotted owl and fisher.

The basic CWHR model, which is the general model we employ, utilizes three components of vegetation: type, size and density. The CWHR type is one of 59 vegetation types from a standard habitat classification scheme. Examples are Sierran mixed conifer, montane chaparral and montane hardwood/conifer (http://www.dfg.ca.gov/whdab/html/wildlife_habitats.html).

CWHR size is the size of the dominant trees, measured by dbh and are divided into size classes (table 1). CWHR density is measured by canopy cover percentage and is divided into four classes (table 2).

For each terrestrial species in the state, the CWHR system contains information to classify the habitat as unsuitable, low, moderate or high suitability based on the CWHR vegetation type, CWHR size class and CWHR density class. To reiterate, for each CWHR type, size and density combination, there exists a habitat suitability class (unsuitable, low, moderate or high) for most terrestrial vertebrates in the state.

Table 1. CWHR size class description

Size of trees (dbh)	Size Class
< 1"	1
1" – 6"	2
6" – 11"	3
11" – 24"	4
> 24"	5
> 24" and multi-storied	6

Furthermore, the CWHR system classifies three important components of habitat suitability separately by assigning suitability classes for cover, feeding and reproduction habitat. For instance, in an area classified as red fir with a size class of 4 and a density class of M, the habitat suitability for the fisher for cover is moderate, for feeding is high and for reproduction is low. This system provides a great deal of flexibility for wildlife biologists and managers to assess the type of habitat they feel is important for a particular analysis.

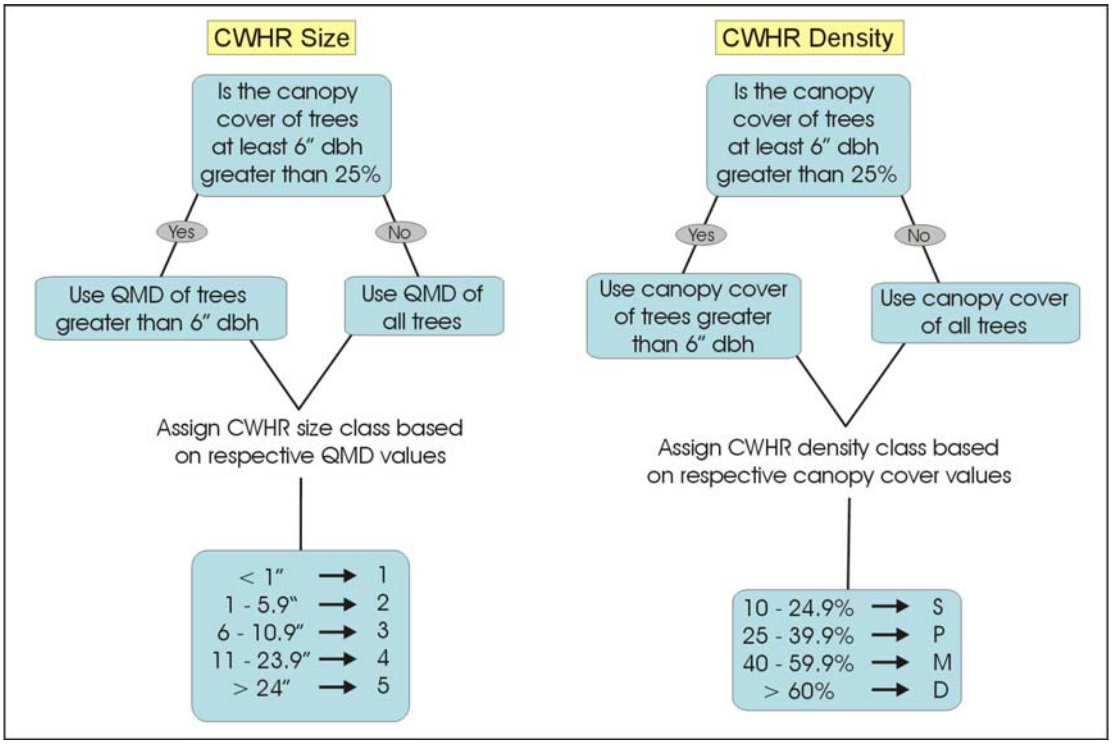
For this analysis, we only characterize the CWHR size and density classes; we omit the CWHR type. This is done for two reasons. First, the species of primary concern, the California spotted owl and fisher, have similar suitability classes among all conifer types (most of the study area is a conifer type). Put another way, the California spotted owl and fisher's suitability classes are *generally* based on CWHR size and density, not CWHR type (within conifer types). Second, translating FVS conventional outputs into CWHR types is extremely difficult and most likely error-prone. This implies that any translations to owl and fisher habitat suitability are based on size and density classes only; CWHR type is not considered in our habitat translations.

Table 2. CWHR density class description

Density of trees (canopy cover)	Density Class
10 – 24%	S
25 – 39%	P
40 – 59%	M
60 – 100%	D

Because FVS does not directly output the CWHR size and density, we developed a method for crosswalking from conventional FVS outputs into CWHR size and density classes (figure 10).

Figure 10. CWHR crosswalk from FVS output to CWHR size and density. QMD refers to quadratic mean diameter



OUTPUT

All outputs for this model are exported from FVS to a Microsoft Access database using the Database Extension to FVS (DB-FVS) (Crookston and Gammel 2004). Each scenario, both with and without a simulated severe fire, has its own database, for a total of six databases:

1) NoActionOut.mdb – This contains the results of the no action alternative.
2) NoActionFireOut.mdb - This contains the results of the no action alternative with the addition of a severe fire in 2015.
3) ProposedOut.mdb - This contains the results of the proposed action.
4) ProposedFireOut.mdb - This contains the results of the proposed action with the addition of a severe fire in 2015.
5) ReducedHarvestOut.mdb - This contains the results of the reduced harvest tree size (30") alternative.
6) ReducedHarvestFireOut.mdb - This contains the results of the reduced harvest tree size (30") alternative with the addition of a severe fire in 2015.

We customized these databases by linking tables and creating four queries that can be modified to yield a desired variable and/or year. All variables should be accessed through either the pre-designed queries, or through modification of the pre-designed queries. Users should not access the database tables directly. There are four "themes" to the queries: fire-related variables, tree-related variables, fisher habitat and California spotted owl habitat. Each of the six databases is formatted the same way and contains all four queries.

Fire-related variables

The fire related variables can be accessed through the query named "FIRE_variables". These variables are those that were generated with the potential fire report. Examples of fire-related variables include torching index and crown bulk density. A complete list of the fire-related variables and their description is located in Appendix G.

Tree-related variables

The tree-related variables can be accessed through the query named "TREE_variables". These variables are those that we created using specific FVS commands and were generated to help FS personnel assess vegetation structure and wildlife habitat characteristics. An example of a tree-related variable is the number of trees in a particular diameter class. A complete list of the tree-related variables and their description is located in Appendix G.

Fisher habitat

The query named "CWHR_fisher" displays the CWHR habitat suitability (unsuitable, low, moderate or high) for the fisher. This query displays habitat suitability for reproduction, cover and feeding. A complete list and description of the fisher habitat variables is located in Appendix G.

California spotted owl habitat

The query named "CWHR_caspo" displays the CWHR habitat suitability (unsuitable, low, moderate or high) for the California spotted owl. This query displays habitat suitability for reproduction, cover and feeding. A complete list and description of the California spotted owl habitat variables is located in Appendix G.

Link to Geographic Information Systems

Any of the variables for any given year can be displayed geographically using common Geographic Information System (GIS) software, such as ArcView GIS (ESRI Inc. 2000) and ArcMap (ESRI Inc. 2004). The GIS layer depicting the simulation units is named "KRP_su.shp". To display any variable geographically, use GIS to link the field "SU_ID" in the GIS layer with the field "SU_ID" in the database queries.

Habitat Animations

We have created animations that geographically display habitat changes through time for the California spotted owl and fisher for the eight management units that will be treated first (Appendix A). These animations show habitat changes through time for the no action, proposed action and reduced harvest tree size alternatives and are embedded within PowerPoint shows. We have also created animations showing the immediate effects of treatment on each of the first eight management units. These animations show fisher and California spotted owl habitat immediately before and after initial treatment. Here is a list of the animation files:

1) caspo_repro.pps – California spotted owl habitat (reproduction) animations.
2) caspo_repro_fire.pps – California spotted owl habitat (reproduction) animations with a severe fire.
3) fisher_repro.pps – Fisher habitat (reproduction) animations.
4) fisher_repro_fire.pps – Fisher habitat (reproduction) animations with a severe fire.

5) caspo_pre_and_post_treatment.pps – California spotted owl habitat suitability immediately before and after initial treatment.
6) Fisher_pre_and_post_treatment.pps – Fisher habitat suitability immediately before and after initial treatment.

ASSESSMENT OF MODEL

Limitations of models

Please be aware that this model is a best attempt to represent reality and that the results of this effort are only approximations of the KRP vegetation under any given alternative. While assumptions used in models tend to simplify natural systems, they offer a method to compare the difference between scenarios. Users may incorrectly assume that model outputs are correct in an absolute sense, model input data are perfect, and/or that all variables have been accounted for in the model. However, model outputs are not absolutely correct, input data are not perfect and many variables may not be accounted for in the model. Rather than wait for the perfect model or the perfect data, we chose to move forward with the knowledge that the preceding was our best attempt at modeling the different alternatives.

We did not intend for this modeling effort to result in precise vegetation information, especially over the geographic scale and time frame encompassed by the KRP. We did intend for this modeling effort to provide the public and decision-makers an indication of the direction of change, estimates of the magnitude of change, and time frames surrounding each change. Our review of model outputs indicates that model results are a reasonable representation of changes in vegetation due to tree growth, fire, and density mortality. Model results may not accurately reflect the absolute change from any activity, but they will reflect the relative differences between alternatives.

Scale of model

No one model can simulate and/or display the range of effects at all ecological scales. These differing scales result in changes in habitat that range from individual tree openings and gaps in forest canopy to large patches or stand level changes and ultimately the larger landscape. These differing ecological scales also affect wildlife habitat. Species such as the California spotted owl have habitat needs that are assessed at a variety of scales: geographic range, home range, nest stand, and nest tree. A comparable ecological scale ranges from the bioregion, landscape (Kings River Project), large patch (sub watershed), patch or stand, gap (several trees) and individual tree (Lewis and Lindgren 2000). Each scale provides a different view of changes in habitat and stand structure.

This particular modeling effort provides a view at the landscape, watershed (management unit), patch (stand) and plant aggregation (simulation unit) scale. Model output simulates plant aggregations (simulation unit) and should be viewed at this scale or larger. One can scale up to larger geographic entities (stand, management unit, project area), but should not scale down by making inferences to individual trees or gaps. Data were gathered at the stand level, thus model results will be the most relevant in assessing changes to vegetation at the stand scale or larger.

Accuracy Assessment

To assess the accuracy of our projected vegetation would be impossible. Instead, we assess the accuracy of the initial vegetation conditions. To do this, we compare the plot-derived CWHR classes to the CWHR classes in the GIS vegetation layer.

This is not a traditional method for determining accuracy, which compares interpreted vegetation to real on-the-ground values obtained from plot data. Here, we compare our interpreted vegetation to what a GIS rendition (which is created with modeling, photo interpretation and site visits) says is on the ground. This GIS rendition of the landscape has its own associated errors and biases, so using it as a comparison of accuracy is not entirely appropriate. However, a comparison to the GIS vegetation layer does give us an indication of the accuracy.

To assess the accuracy, we take simulation units with plot data and compare the plot-derived CWHR classes to the GIS-based CWHR classes. The overall accuracy of the CWHR density class is 48.4%. This means that 48.4% of the simulation units (initial conditions – before any treatment) in the plot-derived CWHR density class match the CWHR density class of the GIS layer (table 7). The overall accuracy of the CWHR size class is 39.1%. This means that 39.1% of the simulation units (initial conditions – before any treatments) in the plot-derived size class match the CWHR size class of the GIS layer.

These accuracy values, although seemingly low, are generally comparable to other fine-scale mapping projects. For example, Ohmann et al. (In Press), although their classification and accuracy assessment methods differed from ours, had an overall accuracy of 47%. Achieving perfect accuracy for multiple vegetation characteristics is impossible, as two plots are never exactly alike nor are the vegetation and explanatory factors perfectly correlated (Ohmann and Gregory 2002).

Although the overall accuracy of the CWHR size and density classes appears low, we feel that there is much that can be learned and gained from this analysis. On a simulation unit basis, there is much error associated with the classification of the CWHR size and density classes to the individual simulation unit. The relatively low accuracy values indicate that the results are not appropriate for decisions or data interpretation at the scale of the simulation unit. However, we strongly feel, as one scales up to the stand, management unit or project area, the accuracy increases to an acceptable level (See Appendix H for further details).

The results of this analysis should not guide planning and policy decisions at simulation unit scale, but should adequately inform decisions at the stand, management unit or project area scale. Assessments at broader spatial scales and coarser attributes (Appendix H) show that our plot-derived habitat values are a reasonable representation of the current habitat conditions.

Recommendations for the future

We have many recommendations that we believe would greatly improve the accuracy of similar modeling efforts. Modeling current and future vegetation is very difficult, and great effort should be made to reduce error and improve the output.

First, we believe it is important that every vegetation plot have spatial coordinates that have minimal error (less than 5 meters). The spatial coordinates of pre-existing plots should be checked by overlaying with digital aerial photographs (DOQQs) and USGS digital 7.5 minute quadrangle maps. If the plot location appears inaccurate, it is necessary to go back to the source and attempt to correct this inaccuracy. If the problem can not be remedied, then that vegetation plot should not be used in any analysis of this sort.

For vegetation plots that will be collected in the future for this project or future projects, we believe that coordinates collected by hand-held GPS may not be accurate enough for a variety of reasons, such as inexperienced GPS users, low-quality GPS receivers and weak satellite signals (blocked by vegetation or topographic features). For these reasons, we believe that in addition to coordinates collected with a GPS, the field personnel collecting the vegetation plot information should also use an aerial photo and use a pin prick to mark their plot location. The GPS coordinates should be compared with the pin prick on the aerial photo at the end of each day, making potential corrections to the geographic location of the plot coordinates while memory of the plot location is still fresh. The use of a personal digital assistant (PDA) with GPS capabilities and running ArcPad (ESRI Inc. 2004) software should be evaluated for this use.

The FVS program was not designed to model wildlife habitat directly. Instead, we used a crosswalk to convert from conventional FVS outputs into CWHR size and density classes. We believe that the crosswalk we used can be improved to predict the CWHR habitat classes. We suggest working closely with FVS personnel to create robust and meaningful methods for extracting CHWR habitat values.

We believe that the delineation of the simulation units can also be dramatically improved. Instead of using the GIS vegetation layer as a major contributor to defining a simulation unit, which has its own associated errors and inconsistencies, we suggest two potential alternatives. One alternative might be to utilize Landsat Thematic Mapper imagery "fused" with Indian Remote Sensing satellite imagery, then using eCognition (Definiens Imaging 2003) to create polygons of relatively of homogeneous pixels. The USDA Forest Service Remote Sensing Lab in Sacramento, California has recently completed a product using these methods in the KRP area (USDA Forest Service 2004). Another alternative might be to utilize satellite imagery on a pixel-by-pixel bases, similar to approaches taken by Ohman and Gregory (2002) and Ohmann et al. (In Press). In this situation, the simulation unit would be the satellite image pixel. The latter approach would only tolerate minimal errors in the spatial location of vegetation plots and techniques for dealing with such a large dataset would need to be developed.

ACKNOWLEGEMENTS

We thank the FVS experts Stephanie Rebain, Nicholas Crookston, Don Vandendriesche, Gary Dixon, Robert Havis, Chad Keyser and Erin Smith-Mateja for their help and patience in this long and arduous process. We also thank Debbie Elliott-Fisk, Jim Quinn and Peter Stine for their helpful comments that greatly improved this document.

BIOSKETCHES

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Ramiro Rojas is currently the District Silviculturist on the High Sierra Ranger District, Sierra National Forest, Pacific Southwest Region, USDA Forest Service. He has a Bachelors of Science Degree from Humboldt State University in Forest Management. He has been a certified silviculturist since 1989. In addition, his experience includes project analysis and fuels prescriptions as a forester in fuels management in the northern Rockies and California. He has been involved in the project level analysis of more than a dozen proposals using forest growth models similar to those presented in this document. He has more than 20 years of field experience in forest management, including fire suppression, fuels management and silviculture.

APPENDIX A – MANAGEMENT UNITS

Project ID	Management Unit	Acres	Proposed Implementation Year	Modeled Implementation Year
1	bear_fen_1	1,017	2012	2012
2	bear_fen_4	578	2017	2017
3	bear_fen_5	1,192	2013	2012
4	bear_fen_6	2,204	2007	2007
5	bear_fen_7	411	2018	2017
6	bull_2	711	2021	2022
7	el_o_win_1	1,359	2006	2007
8	excheque_1	507	2022	2022
9	excheque_3	256	2032	2032
10	excheque_4	263	2032	2032
11	excheque_5	917	2012	2012
12	glen_mdw_1	1,619	2007	2007
13	irock_1	880	2031	2032
14	krew_bul_1	1,152	2007	2007
15	krew_prv_1	1,899	2006	2007
16	n_407_1	611	2031	2032
17	n_407_2	1,009	2017	2017
18	n_407_3	707	2027	2027
19	n_408_1	776	2023	2022
20	n_408_2	609	2032	2032
21	n_409_1	1,120	2022	2022
22	n_409_2	948	2017	2017
23	n_409_3	536	2032	2032
24	n_410_1	750	2031	2032
25	n_410_3	1,639	2032	2032
26	n_417_1	504	2023	2022
27	n_417_2	827	2021	2022
28	n_417_3	1,015	2012	2012
29	n_417_4	829	2028	2027
30	n_417_5	265	2033	2032
31	n_418_1	769	2018	2017
32	n_418_2	704	2016	2017
33	n_418_3	1,007	2027	2027
34	n_419_1	1,586	2033	2032
35	n_419_3	823	2028	2027
36	n_420_1	988	2023	2022
37	n_420_2	638	2018	2017
38	n_420_3	1,045	2026	2027
39	n_420_4	806	2023	2022
40	n_420_5	640	2033	2032
41	n_421_1	989	2033	2032
42	n_421_2	1,111	2016	2017
43	n_421_3	506	2033	2032
44	n_422_1	822	2022	2022
45	n_422_2	992	2031	2032

Project ID	Management Unit	Acres	Implementation Year	Modeled Implementation Year
46	n_423_1	896	2023	2022
47	n_bald_	1,022	2022	2022
48	n_bearcr_1	500	2032	2032
49	n_carls_1	946	2026	2027
50	n_duff_1	757	2013	2012
51	n_duff_2	975	2016	2017
52	n_duff_3	960	2026	2027
53	n_lost_1	724	2012	2012
54	n_lost_2	903	2028	2027
55	n_lost_3	668	2028	2027
56	n_lost_4	576	2028	2027
57	n_mckinl_1	396	2033	2032
58	n_poison_1	989	2027	2027
59	n_ross_1	1,269	2011	2012
60	n_ross_2	1,251	2013	2012
61	n_soapro_1	724	2018	2017
62	n_soapro_2	2,421	2008	2007
63	n_summit_1	659	2013	2012
64	n_summit_2	891	2028	2027
65	n_turtle_1	856	2021	2022
66	n_turtle_2	836	2028	2027
67	n_turtle_3	627	2011	2012
68	n_turtle_4	657	2016	2017
69	n_up_big_1	390	2021	2022
70	n_up_big_2	641	2017	2017
71	n_up_big_3	464	2012	2012
72	providen_1	2,014	2006	2007
72	providen_4	1,047	2006	2007
74	providen_9	829	2011	2012
75	rck_crk_	962	2011	2012
76	reese_1	531	2018	2017
77	reese_2	714	2023	2022
78	sos_1	1,613	2005	2007
79	ten_s_18_	1,647	2026	2027

APPENDIX B – LISTING OF SILVICULTURAL AND FUELS TREATMENT FOR EACH STAND UNDER THE PROPOSED ACTION AND REDUCED HARVEST TREE SIZE (30”) ALTERNATIVES

Stand ID	Plan ID	Mgt. unit	Acres	Modeled treatment year	Management strategy	Modeled fuel treatment	Basal area target (BAT)
657	633	bear_fen_6	125	2007	Uneven-aged	Underburn	200
658	634	bear_fen_6	47	2007	Uneven-aged	Pile burn	200
684	659	bear_fen_6	189	2007	2001 Framework	Underburn	200
696	671	bear_fen_6	160	2007	2001 Framework	Pile burn	200
700	675	bear_fen_6	95	2007	Uneven-aged	Underburn	267
712	0	bear_fen_6	75	2007	2001 Framework	Pile burn	267
730	705	bear_fen_6	19	2007	Uneven-aged	Pile burn	267
736	710	bear_fen_6	171	2007	2001 Framework	Underburn	200
738	712	bear_fen_6	133	2007	2001 Framework	Underburn	200
739	686	bear_fen_6	132	2007	Uneven-aged	Pile burn	267
751	725	bear_fen_6	135	2007	Uneven-aged	Underburn	267
759	1049	bear_fen_6	97	2007	Uneven-aged	Underburn	200
767	742	bear_fen_6	185	2007	Uneven-aged	Underburn	181
787	765	bear_fen_6	99	2007	Uneven-aged	Underburn	133
797	777	bear_fen_6	105	2007	2001 Framework	Pile burn	200
798	733	bear_fen_6	75	2007	Uneven-aged	Underburn	200
808	787	bear_fen_6	130	2007	2001 Framework	Underburn	200
813	792	bear_fen_6	73	2007	2001 Framework	Underburn	181
828	809	bear_fen_6	159	2007	Uneven-aged	Underburn	200
354	1041	el_o_win_1	145	2007	Uneven-aged	Pile burn	200
355	330	el_o_win_1	76	2007	Uneven-aged	Pile burn	200
382	353	el_o_win_1	149	2007	Uneven-aged	Pile burn	200
398	371	el_o_win_1	142	2007	2001 Framework	Underburn	200
412	386	el_o_win_1	176	2007	2001 Framework	Underburn	200
422	329	el_o_win_1	35	2007	Uneven-aged	Pile burn	200
454	431	el_o_win_1	83	2007	Uneven-aged	Pile burn	200
477	455	el_o_win_1	43	2007	Uneven-aged	Pile burn	200
479	457	el_o_win_1	32	2007	Uneven-aged	Underburn	200
480	458	el_o_win_1	100	2007	Uneven-aged	Underburn	167
483	461	el_o_win_1	51	2007	Uneven-aged	Underburn	133
494	472	el_o_win_1	19	2007	Uneven-aged	Underburn	100
496	474	el_o_win_1	84	2007	Uneven-aged	Underburn	167
499	477	el_o_win_1	88	2007	Uneven-aged	Underburn	167
502	480	el_o_win_1	96	2007	Uneven-aged	Underburn	200
506	484	el_o_win_1	42	2007	Uneven-aged	Pile burn	200
148	125	glen_mdw_1	82	2007	Uneven-aged	Pile burn	133
152	129	glen_mdw_1	76	2007	Uneven-aged	Pile burn	200
174	150	glen_mdw_1	116	2007	No treatment	None	na
178	154	glen_mdw_1	44	2007	Uneven-aged	Pile burn	200
197	170	glen_mdw_1	68	2007	2001 Framework	Pile burn	200
216	188	glen_mdw_1	68	2007	No treatment	None	na
217	189	glen_mdw_1	62	2007	No treatment	None	na
218	190	glen_mdw_1	87	2007	Uneven-aged	Pile burn	200
219	237	glen_mdw_1	96	2007	Uneven-aged	Pile burn	167
220	245	glen_mdw_1	123	2007	Uneven-aged	Pile burn	200
226	197	glen_mdw_1	76	2007	2001 Framework	Pile burn	200
244	217	glen_mdw_1	18	2007	Uneven-aged	Pile burn	200
251	225	glen_mdw_1	137	2007	Uneven-aged	Pile burn	200
253	227	glen_mdw_1	69	2007	2001 Framework	Pile burn	200

Stand ID	Plan ID	Mgt. unit	Acres	Modeled treatment year	Management strategy	Modeled fuel treatment	Basal area target (BAT)
297	275	glen_mdw_1	84	2007	2001 Framework	Pile burn	200
311	288	glen_mdw_1	89	2007	Uneven-aged	Pile burn	200
321	296	glen_mdw_1	103	2007	Uneven-aged	Pile burn	200
350	1037	glen_mdw_1	98	2007	Uneven-aged	Pile burn	200
414	388	glen_mdw_1	75	2007	Uneven-aged	Pile burn	200
833	964	krew_bul_1	116	2007	Uneven-aged	Pile burn	200
843	796	krew_bul_1	110	2007	Underburn	Underburn	na
844	965	krew_bul_1	93	2007	Underburn	Underburn	na
845	811	krew_bul_1	134	2007	Uneven-aged	Pile burn	200
855	961	krew_bul_1	98	2007	No treatment	Underburn	na
856	1056	krew_bul_1	67	2007	No treatment	Underburn	na
863	838	krew_bul_1	152	2007	Uneven-aged	Underburn	267
871	962	krew_bul_1	101	2007	Uneven-aged	Pile burn	267
872	1057	krew_bul_1	280	2007	Uneven-aged	Underburn	267
236	208	krew_prv_1	37	2007	Uneven-aged	Pile burn	200
257	235	krew_prv_1	97	2007	Uneven-aged	Underburn	133
258	236	krew_prv_1	59	2007	Uneven-aged	Pile burn	100
272	250	krew_prv_1	28	2007	Uneven-aged	Pile burn	200
302	280	krew_prv_1	75	2007	Uneven-aged	Pile burn	133
303	281	krew_prv_1	71	2007	Uneven-aged	Underburn	133
315	292	krew_prv_1	29	2007	Uneven-aged	Pile burn	200
320	295	krew_prv_1	125	2007	Uneven-aged	Pile burn	133
324	299	krew_prv_1	160	2007	Uneven-aged	Pile burn	133
326	301	krew_prv_1	65	2007	No treatment	Underburn	na
331	306	krew_prv_1	138	2007	Uneven-aged	Underburn	133
340	316	krew_prv_1	158	2007	No treatment	Underburn	na
356	331	krew_prv_1	124	2007	No treatment	Underburn	na
375	346	krew_prv_1	48	2007	Uneven-aged	Underburn	200
394	365	krew_prv_1	85	2007	No treatment	None	na
406	380	krew_prv_1	165	2007	No treatment	None	na
472	449	krew_prv_1	166	2007	2001 Framework	Pile burn	200
473	450	krew_prv_1	83	2007	No treatment	None	na
476	454	krew_prv_1	29	2007	Uneven-aged	Gross yard	128
521	1043	krew_prv_1	87	2007	2001 Framework	Pile burn	181
522	499	krew_prv_1	72	2007	2001 Framework	Pile burn	133
579	553	n_soapro_2	44	2007	Uneven-aged	Pile burn	128
590	568	n_soapro_2	184	2007	Uneven-aged	Pile burn	128
602	579	n_soapro_2	23	2007	No treatment	None	na
611	591	n_soapro_2	123	2007	Uneven-aged	Pile burn	128
621	598	n_soapro_2	150	2007	2001 Framework	Pile burn	200
624	602	n_soapro_2	90	2007	2001 Framework	Underburn	181
632	610	n_soapro_2	95	2007	No treatment	None	na
637	615	n_soapro_2	83	2007	No treatment	None	na
638	616	n_soapro_2	89	2007	2001 Framework	Pile burn	181
644	622	n_soapro_2	34	2007	No treatment	None	na
648	626	n_soapro_2	101	2007	No treatment	None	na
656	632	n_soapro_2	87	2007	Uneven-aged	Underburn	128
664	639	n_soapro_2	163	2007	Uneven-aged	Underburn	101
668	643	n_soapro_2	112	2007	Uneven-aged	Pile burn	128
669	644	n_soapro_2	158	2007	No treatment	None	na
670	645	n_soapro_2	57	2007	No treatment	None	na
677	652	n_soapro_2	275	2007	Uneven-aged	Pile burn	101
679	654	n_soapro_2	13	2007	Uneven-aged	Pile burn	181
683	658	n_soapro_2	66	2007	Uneven-aged	Pile burn	133
687	662	n_soapro_2	51	2007	No treatment	None	na

Stand ID	Plan ID	Mgt. unit	Acres	Modeled treatment year	Modeled treatment	Modeled fuel treatment	Basal area target (BAT)
697	672	n_soapro_2	111	2007	Uneven-aged	Pile burn	128
704	678	n_soapro_2	32	2007	Uneven-aged	Underburn	128
708	681	n_soapro_2	13	2007	Uneven-aged	Pile burn	128
717	691	n_soapro_2	51	2007	Uneven-aged	Pile burn	133
724	698	n_soapro_2	41	2007	Uneven-aged	Pile burn	128
747	721	n_soapro_2	175	2007	Uneven-aged	Pile burn	101
212	184	providen_1	58	2007	Uneven-aged	Gross yard	128
221	192	providen_1	151	2007	Uneven-aged	Pile burn	128
233	205	providen_1	163	2007	Uneven-aged	Pile burn	154
239	212	providen_1	101	2007	Uneven-aged	Gross yard	128
266	244	providen_1	23	2007	Uneven-aged	Pile burn	128
274	253	providen_1	100	2007	Uneven-aged	Gross yard	128
279	257	providen_1	71	2007	Uneven-aged	Pile burn	154
284	262	providen_1	134	2007	Uneven-aged	Pile burn	154
295	273	providen_1	95	2007	2001 Framework	Pile burn	181
298	276	providen_1	97	2007	2001 Framework	Pile burn	181
305	283	providen_1	99	2007	2001 Framework	Pile burn	181
328	303	providen_1	95	2007	Uneven-aged	Pile burn	128
343	319	providen_1	47	2007	2001 Framework	Pile burn	181
344	320	providen_1	126	2007	Uneven-aged	Gross yard	128
352	327	providen_1	30	2007	2001 Framework	Gross yard	181
374	345	providen_1	39	2007	No treatment	None	na
376	347	providen_1	42	2007	Uneven-aged	Gross yard	128
379	350	providen_1	147	2007	Uneven-aged	Pile burn	154
400	373	providen_1	46	2007	Uneven-aged	Pile burn	154
402	375	providen_1	11	2007	Uneven-aged	Underburn	154
405	379	providen_1	51	2007	Uneven-aged	Pile burn	128
410	384	providen_1	101	2007	Uneven-aged	Pile burn	128
424	397	providen_1	52	2007	Uneven-aged	Pile burn	154
432	405	providen_1	23	2007	Uneven-aged	Gross yard	128
449	425	providen_1	23	2007	Uneven-aged	Gross yard	128
450	426	providen_1	88	2007	Uneven-aged	Pile burn	128
500	478	providen_4	89	2007	Uneven-aged	Underburn	154
515	1042	providen_4	193	2007	Uneven-aged	Underburn	128
553	530	providen_4	7	2007	No treatment	None	na
557	533	providen_4	92	2007	Uneven-aged	Pile burn	128
559	956	providen_4	160	2007	No treatment	None	na
568	544	providen_4	156	2007	Uneven-aged	Pile burn	133
601	535	providen_4	188	2007	No treatment	None	na
609	957	providen_4	162	2007	Uneven-aged	Underburn	181
224	195	sos_1	44	2007	Uneven-aged	Gross yard	128
225	196	sos_1	163	2007	Uneven-aged	Pile burn	128
248	220	sos_1	44	2007	Uneven-aged	Pile burn	133
250	224	sos_1	40	2007	Uneven-aged	Pile burn	128
252	226	sos_1	20	2007	Uneven-aged	Pile burn	128
254	228	sos_1	27	2007	Uneven-aged	Underburn	200
256	232	sos_1	32	2007	Uneven-aged	Pile burn	128
275	254	sos_1	47	2007	Uneven-aged	Pile burn	128
285	264	sos_1	35	2007	Uneven-aged	Pile burn	128
288	267	sos_1	76	2007	2001 Framework	Underburn	200
289	268	sos_1	108	2007	2001 Framework	Underburn	133
292	271	sos_1	118	2007	2001 Framework	Pile burn	200
307	285	sos_1	33	2007	Uneven-aged	Pile burn	128
316	293	sos_1	23	2007	Uneven-aged	Pile burn	128
347	323	sos_1	32	2007	Uneven-aged	Pile burn	128

Stand ID	Plan ID	Mgt. unit	Acres	Modeled treatment year	Management strategy	Modeled fuel treatment	Basal area target (BAT)
348	324	sos_1	40	2007	Uneven-aged	Gross yard	128
349	325	sos_1	91	2007	Uneven-aged	Gross yard	128
353	328	sos_1	73	2007	Uneven-aged	Pile burn	133
358	333	sos_1	46	2007	Uneven-aged	Underburn	133
381	352	sos_1	148	2007	Uneven-aged	Pile burn	128
390	361	sos_1	28	2007	2001 Framework	Underburn	200
413	387	sos_1	89	2007	2001 Framework	Pile burn	181
415	389	sos_1	111	2007	2001 Framework	Underburn	128
417	391	sos_1	21	2007	Uneven-aged	Pile burn	128
427	400	sos_1	10	2007	2001 Framework	Pile burn	128
428	401	sos_1	39	2007	2001 Framework	Pile burn	181
451	427	sos_1	13	2007	2001 Framework	Pile burn	181
455	432	sos_1	62	2007	2001 Framework	Pile burn	200
842	822	bear_fen_1	161	2012	Uneven-aged	Pile burn	181
847	825	bear_fen_1	107	2012	Uneven-aged	Pile burn	128
861	836	bear_fen_1	148	2012	Uneven-aged	Underburn	181
862	837	bear_fen_1	131	2012	Uneven-aged	Pile burn	200
865	841	bear_fen_1	72	2012	Uneven-aged	Underburn	128
873	849	bear_fen_1	150	2012	2001 Framework	Pile burn	200
883	863	bear_fen_1	108	2012	2001 Framework	Pile burn	200
891	873	bear_fen_1	142	2012	2001 Framework	Pile burn	200
689	664	bear_fen_5	89	2012	Uneven-aged	Pile burn	200
693	668	bear_fen_5	149	2012	Uneven-aged	Pile burn	133
694	669	bear_fen_5	254	2012	Uneven-aged	Pile burn	181
695	670	bear_fen_5	131	2012	Uneven-aged	Pile burn	200
716	690	bear_fen_5	71	2012	Uneven-aged	Pile burn	128
729	703	bear_fen_5	35	2012	Uneven-aged	Gross yard	181
742	715	bear_fen_5	199	2012	Uneven-aged	Gross yard	101
766	741	bear_fen_5	60	2012	Uneven-aged	Pile burn	101
810	789	bear_fen_5	202	2012	Uneven-aged	Underburn	101
169	135	excheque_5	42	2012	Uneven-aged	Underburn	133
191	164	excheque_5	15	2012	Uneven-aged	Pile burn	200
206	186	excheque_5	77	2012	Uneven-aged	Underburn	133
240	213	excheque_5	90	2012	Uneven-aged	Pile burn	200
246	966	excheque_5	63	2012	Uneven-aged	Pile burn	133
260	967	excheque_5	20	2012	Uneven-aged	Underburn	200
270	248	excheque_5	14	2012	Uneven-aged	Underburn	200
278	256	excheque_5	114	2012	Uneven-aged	Pile burn	200
286	265	excheque_5	114	2012	Uneven-aged	Underburn	200
310	287	excheque_5	54	2012	Uneven-aged	Pile burn	200
322	297	excheque_5	61	2012	Uneven-aged	Pile burn	200
327	302	excheque_5	52	2012	Uneven-aged	Pile burn	133
362	336	excheque_5	59	2012	Uneven-aged	Pile burn	200
385	356	excheque_5	77	2012	Uneven-aged	Pile burn	200
404	377	excheque_5	66	2012	Uneven-aged	Pile burn	200
630	608	n_417_3	121	2012	Uneven-aged	Underburn	200
651	1048	n_417_3	99	2012	Uneven-aged	Pile burn	200
671	646	n_417_3	128	2012	Uneven-aged	Underburn	267
678	653	n_417_3	38	2012	Uneven-aged	Pile burn	200
681	656	n_417_3	63	2012	Uneven-aged	Underburn	200
682	657	n_417_3	31	2012	Uneven-aged	Pile burn	267
685	660	n_417_3	176	2012	Uneven-aged	Pile burn	267
690	665	n_417_3	126	2012	Underburn	Underburn	na
719	693	n_417_3	63	2012	Underburn	Underburn	na
737	711	n_417_3	170	2012	Uneven-aged	Underburn	181

Stand ID	Plan ID	Mgt. unit	Acres	Modeled treatment year	Management strategy	Modeled fuel treatment	Basal area target (BAT)
420	394	n_duff_1	6	2012	Uneven-aged	Underburn	128
423	396	n_duff_1	77	2012	Uneven-aged	Gross yard	181
430	403	n_duff_1	64	2012	Uneven-aged	Gross yard	128
435	409	n_duff_1	36	2012	Uneven-aged	Underburn	101
446	420	n_duff_1	73	2012	Uneven-aged	Gross yard	128
447	422	n_duff_1	12	2012	Uneven-aged	Underburn	181
458	435	n_duff_1	5	2012	Uneven-aged	Underburn	128
459	436	n_duff_1	49	2012	Uneven-aged	Pile burn	200
462	439	n_duff_1	26	2012	Uneven-aged	Underburn	128
465	442	n_duff_1	119	2012	Uneven-aged	Underburn	200
469	446	n_duff_1	106	2012	Uneven-aged	Underburn	154
490	468	n_duff_1	12	2012	Uneven-aged	Underburn	128
507	485	n_duff_1	86	2012	Uneven-aged	Gross yard	154
523	500	n_duff_1	87	2012	Uneven-aged	Underburn	154
528	505	n_lost_1	170	2012	Uneven-aged	Underburn	181
636	614	n_lost_1	98	2012	Uneven-aged	Underburn	181
641	619	n_lost_1	132	2012	Uneven-aged	Underburn	181
661	637	n_lost_1	153	2012	Uneven-aged	Underburn	128
662	638	n_lost_1	6	2012	Uneven-aged	Pile burn	234
665	640	n_lost_1	8	2012	Uneven-aged	Pile burn	234
675	650	n_lost_1	144	2012	Uneven-aged	Underburn	181
714	688	n_lost_1	14	2012	Uneven-aged	Underburn	181
516	494	n_ross_1	44	2012	No treatment	None	na
527	504	n_ross_1	92	2012	Uneven-aged	Underburn	200
538	516	n_ross_1	154	2012	No treatment	None	na
539	517	n_ross_1	52	2012	Uneven-aged	Underburn	200
560	536	n_ross_1	87	2012	Uneven-aged	Underburn	200
562	538	n_ross_1	151	2012	Uneven-aged	Underburn	200
572	546	n_ross_1	161	2012	Uneven-aged	Underburn	200
578	552	n_ross_1	88	2012	Uneven-aged	Pile burn	267
587	565	n_ross_1	41	2012	Uneven-aged	Underburn	267
600	578	n_ross_1	91	2012	Underburn	Underburn	na
617	594	n_ross_1	32	2012	Underburn	Underburn	na
626	604	n_ross_1	130	2012	Uneven-aged	Pile burn	267
631	609	n_ross_1	12	2012	Uneven-aged	Underburn	200
639	617	n_ross_1	29	2012	Uneven-aged	Underburn	200
640	618	n_ross_1	103	2012	Underburn	Underburn	na
701	676	n_ross_2	59	2012	Underburn	Underburn	na
705	679	n_ross_2	68	2012	Uneven-aged	Underburn	267
715	689	n_ross_2	51	2012	Uneven-aged	Underburn	267
722	696	n_ross_2	54	2012	Underburn	Underburn	na
723	697	n_ross_2	67	2012	Uneven-aged	Underburn	267
740	713	n_ross_2	75	2012	Uneven-aged	Underburn	267
744	717	n_ross_2	151	2012	Uneven-aged	Underburn	200
757	731	n_ross_2	40	2012	Uneven-aged	Underburn	200
777	755	n_ross_2	116	2012	Uneven-aged	Underburn	234
779	757	n_ross_2	34	2012	Uneven-aged	Underburn	267
782	760	n_ross_2	190	2012	Underburn	Underburn	na
794	774	n_ross_2	65	2012	Uneven-aged	Pile burn	234
795	775	n_ross_2	47	2012	Underburn	Underburn	na
823	804	n_ross_2	8	2012	Uneven-aged	Pile burn	234
827	808	n_ross_2	126	2012	Uneven-aged	Pile burn	234
832	813	n_ross_2	14	2012	Uneven-aged	Underburn	234
836	816	n_ross_2	85	2012	Uneven-aged	Underburn	181
124	100	n_summit_1	28	2012	Uneven-aged	Pile burn	133

Stand ID	Plan ID	Mgt. unit	Acres	Modeled treatment year	Management strategy	Modeled fuel treatment	Basal area target (BAT)
126	102	n_summit_1	68	2012	No treatment	None	na
132	108	n_summit_1	44	2012	Uneven-aged	Gross yard	200
133	109	n_summit_1	10	2012	Uneven-aged	Gross yard	128
138	114	n_summit_1	7	2012	Uneven-aged	Pile burn	128
142	118	n_summit_1	90	2012	Uneven-aged	Underburn	101
143	119	n_summit_1	73	2012	Uneven-aged	Underburn	181
145	121	n_summit_1	19	2012	Uneven-aged	Underburn	133
151	128	n_summit_1	27	2012	Uneven-aged	Pile burn	154
153	130	n_summit_1	8	2012	Uneven-aged	Gross yard	128
157	134	n_summit_1	13	2012	Uneven-aged	Underburn	200
167	144	n_summit_1	92	2012	Uneven-aged	Gross yard	181
170	146	n_summit_1	52	2012	Uneven-aged	Gross yard	128
180	156	n_summit_1	41	2012	Uneven-aged	Pile burn	101
182	157	n_summit_1	66	2012	Uneven-aged	Gross yard	128
183	158	n_summit_1	10	2012	Uneven-aged	Gross yard	167
192	165	n_summit_1	10	2012	Uneven-aged	Gross yard	167
897	882	n_turtle_3	145	2012	Uneven-aged	Underburn	200
904	893	n_turtle_3	222	2012	Uneven-aged	Underburn	267
911	899	n_turtle_3	151	2012	Underburn	Underburn	na
914	902	n_turtle_3	110	2012	Underburn	Underburn	na
198	171	n_up_big_3	87	2012	Uneven-aged	Pile burn	181
201	174	n_up_big_3	91	2012	Uneven-aged	Gross yard	181
271	249	n_up_big_3	86	2012	Uneven-aged	Underburn	181
304	282	n_up_big_3	104	2012	Uneven-aged	Underburn	181
325	300	n_up_big_3	75	2012	Uneven-aged	Underburn	181
342	318	n_up_big_3	20	2012	Uneven-aged	Gross yard	101
431	404	providen_9	99	2012	Uneven-aged	Underburn	154
434	408	providen_9	62	2012	Uneven-aged	Pile burn	128
438	412	providen_9	81	2012	Uneven-aged	Pile burn	128
439	413	providen_9	20	2012	Uneven-aged	Pile burn	128
466	443	providen_9	256	2012	Uneven-aged	Pile burn	128
482	460	providen_9	76	2012	Uneven-aged	Pile burn	181
491	469	providen_9	87	2012	Uneven-aged	Pile burn	154
501	479	providen_9	148	2012	Uneven-aged	Pile burn	181
61	32	rck_crk_	113	2012	Uneven-aged	Pile burn	181
68	1031	rck_crk_	272	2012	Uneven-aged	Pile burn	234
70	1004	rck_crk_	92	2012	Uneven-aged	Pile burn	267
76	37	rck_crk_	123	2012	Uneven-aged	Pile burn	267
83	1003	rck_crk_	42	2012	Uneven-aged	Pile burn	267
96	70	rck_crk_	98	2012	Uneven-aged	Pile burn	100
100	74	rck_crk_	98	2012	Uneven-aged	Pile burn	267
119	95	rck_crk_	48	2012	Uneven-aged	Pile burn	100
121	97	rck_crk_	16	2012	Uneven-aged	Pile burn	267
141	117	rck_crk_	59	2012	Uneven-aged	Underburn	200
788	766	bear_fen_4	336	2017	Uneven-aged	Pile burn	128
789	767	bear_fen_4	242	2017	Uneven-aged	Underburn	101
811	790	bear_fen_7	142	2017	Uneven-aged	Underburn	181
838	818	bear_fen_7	146	2017	Uneven-aged	Pile burn	128
858	833	bear_fen_7	122	2017	Uneven-aged	Pile burn	181
9	9	n_407_2	152	2017	Uneven-aged	Pile burn	267
21	983	n_407_2	285	2017	Uneven-aged	Pile burn	267
23	984	n_407_2	73	2017	Uneven-aged	Pile burn	267
28	987	n_407_2	22	2017	Uneven-aged	Pile burn	200
31	19	n_407_2	132	2017	Uneven-aged	Pile burn	267
38	991	n_407_2	40	2017	Uneven-aged	Pile burn	200

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42	993	n_407_2	72	2017	Uneven-aged	Pile burn	267
47	994	n_407_2	44	2017	Uneven-aged	Pile burn	200
48	995	n_407_2	141	2017	Uneven-aged	Pile burn	200
51	996	n_407_2	49	2017	Uneven-aged	Pile burn	200
12	978	n_409_2	137	2017	Uneven-aged	Pile burn	267
16	981	n_409_2	44	2017	Uneven-aged	Underburn	200
25	985	n_409_2	123	2017	Uneven-aged	Pile burn	267
32	990	n_409_2	102	2017	Uneven-aged	Underburn	267
33	1028	n_409_2	64	2017	Uneven-aged	Pile burn	267
35	1029	n_409_2	63	2017	Uneven-aged	Pile burn	267
40	22	n_409_2	371	2017	Uneven-aged	Pile burn	267
43	1027	n_409_2	44	2017	Uneven-aged	Pile burn	267
135	111	n_418_1	168	2017	Uneven-aged	Pile burn	100
139	115	n_418_1	181	2017	Uneven-aged	Pile burn	267
200	173	n_418_1	248	2017	Uneven-aged	Pile burn	267
222	193	n_418_1	172	2017	Uneven-aged	Pile burn	267
265	243	n_418_2	69	2017	Uneven-aged	Pile burn	267
269	1034	n_418_2	219	2017	Uneven-aged	Pile burn	267
334	309	n_418_2	13	2017	Uneven-aged	Pile burn	267
335	310	n_418_2	7	2017	Uneven-aged	Pile burn	267
339	315	n_418_2	101	2017	Uneven-aged	Pile burn	267
345	322	n_418_2	63	2017	Uneven-aged	Pile burn	267
361	335	n_418_2	17	2017	Uneven-aged	Pile burn	267
372	343	n_418_2	18	2017	Uneven-aged	Pile burn	267
388	359	n_418_2	131	2017	Uneven-aged	Pile burn	267
389	360	n_418_2	40	2017	Uneven-aged	Pile burn	267
403	376	n_418_2	25	2017	Uneven-aged	Pile burn	267
519	497	n_420_2	28	2017	No treatment	None	na
526	503	n_420_2	128	2017	No treatment	None	na
544	521	n_420_2	85	2017	No treatment	None	na
561	537	n_420_2	73	2017	No treatment	None	na
566	542	n_420_2	82	2017	No treatment	None	na
577	551	n_420_2	53	2017	No treatment	None	na
589	567	n_420_2	189	2017	No treatment	None	na
634	612	n_421_2	160	2017	Uneven-aged	Underburn	267
635	613	n_421_2	141	2017	Uneven-aged	Pile burn	267
666	641	n_421_2	208	2017	Uneven-aged	Pile burn	267
686	661	n_421_2	94	2017	Uneven-aged	Pile burn	267
688	663	n_421_2	218	2017	Uneven-aged	Pile burn	267
699	674	n_421_2	117	2017	Uneven-aged	Pile burn	267
732	707	n_421_2	173	2017	Uneven-aged	Pile burn	267
441	415	n_duff_2	98	2017	Uneven-aged	Underburn	181
457	434	n_duff_2	87	2017	Uneven-aged	Underburn	181
460	437	n_duff_2	61	2017	Uneven-aged	Underburn	154
464	441	n_duff_2	86	2017	Uneven-aged	Underburn	154
486	464	n_duff_2	26	2017	Uneven-aged	Underburn	154
510	489	n_duff_2	139	2017	Uneven-aged	Underburn	181
517	495	n_duff_2	48	2017	Uneven-aged	Underburn	154
518	496	n_duff_2	53	2017	Uneven-aged	Underburn	181
525	502	n_duff_2	80	2017	Uneven-aged	Underburn	181
536	514	n_duff_2	120	2017	Uneven-aged	Underburn	154
537	515	n_duff_2	20	2017	Uneven-aged	Underburn	154
548	525	n_duff_2	93	2017	Uneven-aged	Underburn	154
550	527	n_duff_2	57	2017	Uneven-aged	Underburn	128
583	558	n_duff_2	7	2017	Uneven-aged	Underburn	128

Stand ID	Plan ID	Mgt. unit	Acres	Modeled treatment year	Management strategy	Modeled fuel treatment	Basal area target (BAT)
487	465	n_soapro_1	62	2017	Uneven-aged	Underburn	128
509	488	n_soapro_1	213	2017	Uneven-aged	Underburn	154
534	511	n_soapro_1	163	2017	Uneven-aged	Underburn	154
545	522	n_soapro_1	175	2017	Uneven-aged	Underburn	154
549	526	n_soapro_1	45	2017	Uneven-aged	Underburn	128
573	547	n_soapro_1	67	2017	Uneven-aged	Pile burn	128
154	1005	n_summit_2	256	2017	Uneven-aged	Pile burn	167
179	155	n_summit_2	62	2017	Uneven-aged	Gross yard	128
181	131	n_summit_2	251	2017	No treatment	None	na
213	185	n_summit_2	88	2017	No treatment	None	na
231	203	n_summit_2	58	2017	Uneven-aged	Underburn	154
242	215	n_summit_2	49	2017	Uneven-aged	Underburn	154
267	246	n_summit_2	121	2017	Uneven-aged	Pile burn	154
300	278	n_summit_2	7	2017	Uneven-aged	Pile burn	167
867	843	n_turtle_4	244	2017	Underburn	Underburn	na
870	847	n_turtle_4	30	2017	Uneven-aged	Underburn	267
893	876	n_turtle_4	186	2017	Uneven-aged	Underburn	181
913	901	n_turtle_4	99	2017	Uneven-aged	Underburn	181
915	903	n_turtle_4	45	2017	Uneven-aged	Pile burn	267
916	904	n_turtle_4	46	2017	Uneven-aged	Pile burn	100
920	906	n_turtle_4	6	2017	Uneven-aged	Pile burn	267
101	75	n_up_big_2	40	2017	Uneven-aged	Pile burn	200
104	79	n_up_big_2	14	2017	Uneven-aged	Underburn	128
105	80	n_up_big_2	8	2017	Uneven-aged	Pile burn	200
110	85	n_up_big_2	86	2017	Uneven-aged	Gross yard	128
111	86	n_up_big_2	16	2017	Uneven-aged	Pile burn	200
112	87	n_up_big_2	39	2017	Uneven-aged	Underburn	133
114	89	n_up_big_2	175	2017	Uneven-aged	Gross yard	200
122	98	n_up_big_2	17	2017	Uneven-aged	Pile burn	200
127	103	n_up_big_2	29	2017	Uneven-aged	Pile burn	133
129	105	n_up_big_2	101	2017	Uneven-aged	Gross yard	154
166	143	n_up_big_2	116	2017	Uneven-aged	Gross yard	181
74	42	reese_1	70	2017	Uneven-aged	Underburn	200
77	46	reese_1	66	2017	Uneven-aged	Underburn	267
82	52	reese_1	17	2017	Uneven-aged	Underburn	267
84	53	reese_1	196	2017	Uneven-aged	Underburn	200
91	62	reese_1	55	2017	Uneven-aged	Underburn	267
95	69	reese_1	72	2017	Uneven-aged	Underburn	200
117	1032	reese_1	46	2017	Uneven-aged	Underburn	200
150	127	reese_1	9	2017	Uneven-aged	Underburn	267
869	1052	bull_2	102	2022	Uneven-aged	Underburn	267
895	1051	bull_2	173	2022	Uneven-aged	Pile burn	267
905	896	bull_2	102	2022	Uneven-aged	Pile burn	267
912	900	bull_2	146	2022	Uneven-aged	Pile burn	267
923	1055	bull_2	110	2022	Uneven-aged	Pile burn	267
928	910	bull_2	78	2022	Uneven-aged	Pile burn	200
336	311	excheque_1	54	2022	Uneven-aged	Pile burn	133
363	337	excheque_1	226	2022	Uneven-aged	Pile burn	133
371	342	excheque_1	58	2022	Uneven-aged	Pile burn	133
452	428	excheque_1	101	2022	Uneven-aged	Pile burn	200
470	447	excheque_1	69	2022	Uneven-aged	Pile burn	200
7	975	n_408_1	232	2022	Uneven-aged	Pile burn	200
15	980	n_408_1	308	2022	Uneven-aged	Pile burn	267
26	13	n_408_1	135	2022	Uneven-aged	Underburn	267
30	989	n_408_1	101	2022	Uneven-aged	Pile burn	267

Stand ID	Plan ID	Mgt. unit	Acres	Modeled treatment year	Management strategy	Modeled fuel treatment	Basal area target (BAT)
6	7	n_409_1	158	2022	Uneven-aged	Underburn	267
8	976	n_409_1	97	2022	Uneven-aged	Pile burn	267
11	977	n_409_1	163	2022	Uneven-aged	Pile burn	267
14	1030	n_409_1	164	2022	Underburn	Underburn	na
20	15	n_409_1	146	2022	Uneven-aged	Pile burn	267
22	17	n_409_1	264	2022	Uneven-aged	Pile burn	267
37	12	n_409_1	128	2022	Uneven-aged	Underburn	267
511	490	n_417_1	103	2022	Uneven-aged	Pile burn	200
513	492	n_417_1	36	2022	Uneven-aged	Underburn	167
531	1044	n_417_1	96	2022	Uneven-aged	Underburn	167
535	512	n_417_1	73	2022	Uneven-aged	Pile burn	167
555	508	n_417_1	63	2022	Uneven-aged	Underburn	200
563	539	n_417_1	72	2022	Underburn	Underburn	na
564	1047	n_417_1	61	2022	Uneven-aged	Pile burn	267
595	573	n_417_2	91	2022	Uneven-aged	Underburn	267
605	540	n_417_2	42	2022	Uneven-aged	Pile burn	200
615	593	n_417_2	126	2022	Uneven-aged	Underburn	267
654	630	n_417_2	147	2022	Uneven-aged	Underburn	267
692	667	n_417_2	94	2022	Uneven-aged	Underburn	234
706	680	n_417_2	134	2022	Uneven-aged	Underburn	234
720	694	n_417_2	192	2022	Underburn	Underburn	na
387	358	n_420_1	53	2022	Uneven-aged	Underburn	267
393	364	n_420_1	61	2022	Uneven-aged	Pile burn	267
411	385	n_420_1	69	2022	Uneven-aged	Pile burn	267
416	390	n_420_1	93	2022	Uneven-aged	Pile burn	267
442	416	n_420_1	53	2022	Uneven-aged	Pile burn	267
461	438	n_420_1	86	2022	Uneven-aged	Pile burn	267
463	440	n_420_1	51	2022	Uneven-aged	Pile burn	267
475	453	n_420_1	20	2022	Uneven-aged	Pile burn	267
481	459	n_420_1	39	2022	Uneven-aged	Pile burn	267
485	463	n_420_1	64	2022	Uneven-aged	Pile burn	267
488	466	n_420_1	17	2022	Uneven-aged	Pile burn	267
495	473	n_420_1	93	2022	Uneven-aged	Pile burn	267
503	481	n_420_1	16	2022	Uneven-aged	Pile burn	267
504	482	n_420_1	96	2022	Uneven-aged	Pile burn	267
505	483	n_420_1	15	2022	Uneven-aged	Pile burn	267
508	487	n_420_1	160	2022	Uneven-aged	Pile burn	267
351	326	n_420_4	72	2022	Uneven-aged	Underburn	267
357	332	n_420_4	82	2022	Uneven-aged	Pile burn	267
391	362	n_420_4	37	2022	Uneven-aged	Pile burn	267
397	368	n_420_4	121	2022	Uneven-aged	Underburn	200
399	372	n_420_4	69	2022	Uneven-aged	Pile burn	267
408	382	n_420_4	271	2022	Uneven-aged	Pile burn	267
418	392	n_420_4	72	2022	Uneven-aged	Underburn	267
443	417	n_420_4	83	2022	Uneven-aged	Underburn	267
718	692	n_422_1	158	2022	No treatment	None	na
735	704	n_422_1	140	2022	No treatment	None	na
748	722	n_422_1	105	2022	No treatment	None	na
768	743	n_422_1	103	2022	No treatment	None	na
770	745	n_422_1	161	2022	No treatment	None	na
830	1050	n_422_1	28	2022	No treatment	None	na
834	814	n_422_1	82	2022	No treatment	None	na
835	815	n_422_1	46	2022	No treatment	None	na
764	739	n_423_1	196	2022	Uneven-aged	Pile burn	267
771	746	n_423_1	229	2022	Uneven-aged	Pile burn	267

Stand ID	Plan ID	Mgt. unit	Acres	Modeled treatment year	Management strategy	Modeled fuel treatment	Basal area target (BAT)
780	758	n_423_1	223	2022	Uneven-aged	Pile burn	267
793	772	n_423_1	59	2022	Uneven-aged	Pile burn	200
812	791	n_423_1	68	2022	No treatment	Underburn	na
825	806	n_423_1	121	2022	Uneven-aged	Pile burn	200
71	1002	n_bald_	165	2022	No treatment	None	na
87	57	n_bald_	238	2022	No treatment	None	na
94	67	n_bald_	92	2022	No treatment	None	na
97	71	n_bald_	15	2022	No treatment	None	na
102	76	n_bald_	138	2022	No treatment	None	na
109	84	n_bald_	116	2022	No treatment	None	na
136	112	n_bald_	35	2022	No treatment	None	na
137	113	n_bald_	92	2022	No treatment	None	na
149	126	n_bald_	15	2022	No treatment	None	na
176	152	n_bald_	41	2022	No treatment	None	na
203	176	n_bald_	40	2022	No treatment	None	na
211	183	n_bald_	17	2022	No treatment	None	na
215	187	n_bald_	18	2022	No treatment	None	na
846	824	n_turtle_1	146	2022	Uneven-aged	Underburn	234
851	828	n_turtle_1	203	2022	Uneven-aged	Underburn	200
877	853	n_turtle_1	62	2022	Uneven-aged	Underburn	181
884	864	n_turtle_1	8	2022	Uneven-aged	Underburn	181
885	866	n_turtle_1	297	2022	Uneven-aged	Underburn	234
889	871	n_turtle_1	61	2022	Uneven-aged	Underburn	234
896	881	n_turtle_1	78	2022	Uneven-aged	Underburn	181
155	132	n_up_big_1	83	2022	Uneven-aged	Pile burn	154
168	145	n_up_big_1	22	2022	Uneven-aged	Underburn	128
189	1057	n_up_big_1	58	2022	Uneven-aged	Underburn	267
228	199	n_up_big_1	47	2022	Uneven-aged	Gross yard	101
230	201	n_up_big_1	57	2022	Uneven-aged	Underburn	128
277	255	n_up_big_1	60	2022	Uneven-aged	Underburn	128
296	274	n_up_big_1	62	2022	Uneven-aged	Underburn	128
118	93	reese_2	54	2022	Underburn	Underburn	na
128	104	reese_2	47	2022	Underburn	Underburn	na
140	116	reese_2	96	2022	Uneven-aged	Underburn	200
144	120	reese_2	45	2022	Underburn	Underburn	na
156	133	reese_2	68	2022	Uneven-aged	Underburn	200
162	140	reese_2	98	2022	Uneven-aged	Underburn	200
165	142	reese_2	43	2022	Uneven-aged	Underburn	200
199	172	reese_2	163	2022	Uneven-aged	Pile burn	200
208	180	reese_2	29	2022	Uneven-aged	Pile burn	200
287	266	reese_2	73	2022	Uneven-aged	Pile burn	200
45	21	n_407_3	122	2027	Underburn	Underburn	na
50	26	n_407_3	272	2027	Uneven-aged	Pile burn	267
56	1001	n_407_3	107	2027	Uneven-aged	Pile burn	181
59	31	n_407_3	108	2027	Uneven-aged	Pile burn	234
60	29	n_407_3	97	2027	Uneven-aged	Pile burn	267
588	566	n_417_4	25	2027	No treatment	None	na
597	575	n_417_4	124	2027	No treatment	None	na
604	581	n_417_4	33	2027	No treatment	None	na
610	589	n_417_4	33	2027	No treatment	None	na
619	596	n_417_4	18	2027	No treatment	None	na
627	605	n_417_4	17	2027	No treatment	None	na
633	611	n_417_4	33	2027	No treatment	None	na
645	623	n_417_4	107	2027	No treatment	None	na
650	628	n_417_4	39	2027	No treatment	None	na

Stand ID	Plan ID	Mgt. unit	Acres	Modeled treatment year	Management strategy	Modeled fuel treatment	Basal area target (BAT)
655	631	n_417_4	96	2027	No treatment	None	na
667	642	n_417_4	86	2027	No treatment	None	na
672	647	n_417_4	54	2027	No treatment	None	na
674	649	n_417_4	32	2027	No treatment	None	na
691	666	n_417_4	55	2027	No treatment	None	na
713	687	n_417_4	77	2027	No treatment	None	na
293	970	n_418_3	68	2027	No treatment	None	na
299	277	n_418_3	26	2027	No treatment	None	na
309	252	n_418_3	63	2027	No treatment	None	na
332	307	n_418_3	20	2027	No treatment	None	na
337	313	n_418_3	31	2027	No treatment	None	na
341	317	n_418_3	98	2027	No treatment	None	na
377	348	n_418_3	79	2027	No treatment	None	na
378	349	n_418_3	24	2027	No treatment	None	na
419	393	n_418_3	78	2027	No treatment	None	na
421	395	n_418_3	81	2027	No treatment	None	na
426	399	n_418_3	25	2027	No treatment	None	na
429	402	n_418_3	72	2027	No treatment	None	na
433	407	n_418_3	25	2027	No treatment	None	na
436	410	n_418_3	115	2027	No treatment	None	na
437	411	n_418_3	28	2027	No treatment	None	na
440	414	n_418_3	82	2027	No treatment	None	na
445	419	n_418_3	20	2027	No treatment	None	na
456	433	n_418_3	10	2027	No treatment	None	na
467	444	n_418_3	18	2027	No treatment	None	na
468	445	n_418_3	15	2027	No treatment	None	na
484	462	n_418_3	8	2027	No treatment	None	na
489	467	n_418_3	21	2027	No treatment	None	na
196	169	n_419_3	241	2027	Uneven-aged	Pile burn	200
229	200	n_419_3	170	2027	Uneven-aged	Pile burn	200
263	240	n_419_3	285	2027	Uneven-aged	Pile burn	267
360	321	n_419_3	128	2027	Uneven-aged	Pile burn	267
533	510	n_420_3	72	2027	Uneven-aged	Pile burn	267
547	524	n_420_3	283	2027	Uneven-aged	Pile burn	267
565	541	n_420_3	96	2027	Uneven-aged	Pile burn	267
603	580	n_420_3	106	2027	Uneven-aged	Pile burn	267
612	571	n_420_3	216	2027	Uneven-aged	Pile burn	267
618	595	n_420_3	68	2027	Uneven-aged	Pile burn	267
623	600	n_420_3	34	2027	Uneven-aged	Pile burn	267
646	624	n_420_3	24	2027	Uneven-aged	Pile burn	267
649	627	n_420_3	148	2027	Uneven-aged	Pile burn	267
753	727	n_carls_1	36	2027	Uneven-aged	Underburn	234
754	728	n_carls_1	16	2027	Uneven-aged	Underburn	234
755	729	n_carls_1	45	2027	Uneven-aged	Underburn	267
769	744	n_carls_1	18	2027	Uneven-aged	Underburn	181
772	747	n_carls_1	14	2027	Uneven-aged	Underburn	267
773	748	n_carls_1	40	2027	Uneven-aged	Underburn	267
778	756	n_carls_1	100	2027	Uneven-aged	Underburn	267
781	759	n_carls_1	103	2027	Uneven-aged	Underburn	234
783	761	n_carls_1	67	2027	Uneven-aged	Underburn	181
784	762	n_carls_1	18	2027	Uneven-aged	Underburn	267
791	770	n_carls_1	21	2027	Uneven-aged	Underburn	267
799	778	n_carls_1	50	2027	Uneven-aged	Underburn	267
803	782	n_carls_1	16	2027	Uneven-aged	Underburn	267
804	783	n_carls_1	18	2027	Uneven-aged	Underburn	267

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809	788	n_carls_1	29	2027	Uneven-aged	Underburn	267
815	794	n_carls_1	35	2027	Uneven-aged	Underburn	181
816	795	n_carls_1	22	2027	Uneven-aged	Underburn	267
819	798	n_carls_1	20	2027	Uneven-aged	Underburn	267
824	805	n_carls_1	38	2027	Uneven-aged	Underburn	234
829	810	n_carls_1	7	2027	Uneven-aged	Pile burn	267
831	812	n_carls_1	188	2027	Uneven-aged	Underburn	200
841	821	n_carls_1	47	2027	Uneven-aged	Underburn	181
543	520	n_duff_3	181	2027	Uneven-aged	Underburn	181
551	528	n_duff_3	213	2027	Uneven-aged	Underburn	181
575	549	n_duff_3	111	2027	Uneven-aged	Pile burn	128
592	570	n_duff_3	52	2027	Uneven-aged	Underburn	181
594	572	n_duff_3	15	2027	Uneven-aged	Underburn	128
596	574	n_duff_3	7	2027	Uneven-aged	Underburn	128
606	582	n_duff_3	60	2027	Uneven-aged	Pile burn	181
614	592	n_duff_3	6	2027	Uneven-aged	Pile burn	128
620	597	n_duff_3	20	2027	Uneven-aged	Underburn	128
622	599	n_duff_3	61	2027	Uneven-aged	Underburn	128
642	620	n_duff_3	29	2027	Uneven-aged	Pile burn	128
643	621	n_duff_3	50	2027	Uneven-aged	Underburn	128
647	625	n_duff_3	117	2027	Uneven-aged	Pile burn	181
676	651	n_duff_3	19	2027	Uneven-aged	Pile burn	128
709	683	n_duff_3	9	2027	Uneven-aged	Underburn	181
721	695	n_duff_3	10	2027	Uneven-aged	Pile burn	128
652	629	n_lost_2	115	2027	Underburn	Underburn	na
725	699	n_lost_2	130	2027	Underburn	Underburn	na
728	702	n_lost_2	177	2027	Uneven-aged	Underburn	128
734	709	n_lost_2	20	2027	Uneven-aged	Pile burn	128
749	723	n_lost_2	93	2027	Uneven-aged	Underburn	128
750	724	n_lost_2	43	2027	Uneven-aged	Pile burn	234
762	736	n_lost_2	35	2027	Uneven-aged	Pile burn	128
785	763	n_lost_2	238	2027	Uneven-aged	Pile burn	101
805	784	n_lost_2	53	2027	Uneven-aged	Pile burn	101
625	603	n_lost_3	255	2027	Uneven-aged	Gross yard	128
628	606	n_lost_3	87	2027	Uneven-aged	Pile burn	181
703	677	n_lost_3	27	2027	Uneven-aged	Pile burn	234
731	706	n_lost_3	281	2027	Uneven-aged	Gross yard	128
763	737	n_lost_3	18	2027	Uneven-aged	Pile burn	128
653	958	n_lost_4	87	2027	No treatment	None	na
660	636	n_lost_4	120	2027	No treatment	None	na
663	586	n_lost_4	112	2027	No treatment	None	na
702	959	n_lost_4	168	2027	No treatment	None	na
707	960	n_lost_4	89	2027	No treatment	None	na
910	898	n_poison_1	273	2027	Uneven-aged	Underburn	267
918	1053	n_poison_1	312	2027	Underburn	Underburn	na
921	908	n_poison_1	207	2027	Underburn	Underburn	na
925	922	n_poison_1	198	2027	Uneven-aged	Pile burn	133
839	819	n_turtle_2	101	2027	Uneven-aged	Underburn	200
840	820	n_turtle_2	68	2027	Uneven-aged	Underburn	267
850	827	n_turtle_2	29	2027	Uneven-aged	Underburn	267
853	830	n_turtle_2	133	2027	Uneven-aged	Underburn	267
857	832	n_turtle_2	189	2027	Uneven-aged	Underburn	181
859	834	n_turtle_2	26	2027	Uneven-aged	Underburn	267
875	851	n_turtle_2	91	2027	Uneven-aged	Underburn	200
879	856	n_turtle_2	36	2027	Uneven-aged	Underburn	181

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887	868	n_turtle_2	123	2027	Uneven-aged	Underburn	200
892	874	n_turtle_2	39	2027	Uneven-aged	Underburn	181
106	81	ten_s_18_	73	2027	Uneven-aged	Underburn	128
130	106	ten_s_18_	88	2027	Uneven-aged	Underburn	128
131	107	ten_s_18_	74	2027	Uneven-aged	Underburn	128
172	148	ten_s_18_	72	2027	Uneven-aged	Gross yard	128
175	151	ten_s_18_	46	2027	Uneven-aged	Gross yard	128
184	159	ten_s_18_	71	2027	Uneven-aged	Gross yard	128
202	175	ten_s_18_	97	2027	Uneven-aged	Gross yard	128
204	177	ten_s_18_	119	2027	Uneven-aged	Underburn	128
243	216	ten_s_18_	42	2027	Uneven-aged	Underburn	128
291	270	ten_s_18_	143	2027	Uneven-aged	Underburn	133
359	334	ten_s_18_	68	2027	Uneven-aged	Underburn	200
365	339	ten_s_18_	123	2027	Uneven-aged	Underburn	181
373	344	ten_s_18_	72	2027	Uneven-aged	Underburn	200
383	354	ten_s_18_	138	2027	Uneven-aged	Underburn	181
386	357	ten_s_18_	62	2027	Uneven-aged	Underburn	181
392	363	ten_s_18_	50	2027	Uneven-aged	Underburn	181
395	366	ten_s_18_	127	2027	Uneven-aged	Underburn	181
409	383	ten_s_18_	182	2027	Uneven-aged	Underburn	181
273	968	excheque_3	41	2032	Uneven-aged	Pile burn	100
276	969	excheque_3	46	2032	Uneven-aged	Pile burn	100
280	258	excheque_3	22	2032	Uneven-aged	Underburn	200
282	260	excheque_3	49	2032	Uneven-aged	Pile burn	100
294	272	excheque_3	30	2032	Uneven-aged	Pile burn	100
314	291	excheque_3	70	2032	Uneven-aged	Pile burn	200
223	210	excheque_4	37	2032	Uneven-aged	Pile burn	200
232	219	excheque_4	26	2032	Uneven-aged	Pile burn	267
238	211	excheque_4	24	2032	Uneven-aged	Pile burn	267
241	214	excheque_4	17	2032	Uneven-aged	Underburn	267
245	229	excheque_4	22	2032	Uneven-aged	Underburn	200
249	223	excheque_4	34	2032	Uneven-aged	Underburn	267
255	233	excheque_4	37	2032	Uneven-aged	Pile burn	200
261	238	excheque_4	20	2032	Uneven-aged	Pile burn	100
264	242	excheque_4	45	2032	Uneven-aged	Pile burn	267
919	907	irock_1	130	2032	Uneven-aged	Underburn	267
924	911	irock_1	31	2032	Underburn	Underburn	na
926	1054	irock_1	165	2032	Uneven-aged	Underburn	267
927	912	irock_1	58	2032	Underburn	Underburn	na
931	915	irock_1	66	2032	Uneven-aged	Underburn	200
932	916	irock_1	63	2032	Underburn	Underburn	na
933	917	irock_1	122	2032	Uneven-aged	Underburn	200
934	919	irock_1	99	2032	Uneven-aged	Underburn	267
935	920	irock_1	10	2032	Uneven-aged	Underburn	101
936	921	irock_1	105	2032	Uneven-aged	Underburn	200
938	924	irock_1	32	2032	Uneven-aged	Underburn	267
13	979	n_407_1	40	2032	Uneven-aged	Underburn	200
17	982	n_407_1	165	2032	Uneven-aged	Pile burn	267
18	11	n_407_1	233	2032	Uneven-aged	Pile burn	267
24	18	n_407_1	83	2032	Uneven-aged	Pile burn	200
29	988	n_407_1	90	2032	Uneven-aged	Pile burn	200
3	3	n_408_2	301	2032	Uneven-aged	Pile burn	267
4	4	n_408_2	309	2032	Uneven-aged	Pile burn	267
44	8	n_409_3	64	2032	No treatment	None	na
49	25	n_409_3	165	2032	No treatment	None	na

Stand ID	Plan ID	Mgt. unit	Acres	Modeled treatment year	Management strategy	Modeled fuel treatment	Basal area target (BAT)
52	997	n_409_3	92	2032	No treatment	None	na
54	971	n_409_3	117	2032	No treatment	None	na
58	998	n_409_3	64	2032	No treatment	None	na
62	972	n_409_3	34	2032	No treatment	None	na
69	973	n_410_1	233	2032	No treatment	None	na
78	974	n_410_1	108	2032	No treatment	None	na
79	47	n_410_1	85	2032	No treatment	None	na
80	50	n_410_1	9	2032	No treatment	None	na
81	51	n_410_1	185	2032	No treatment	None	na
88	58	n_410_1	9	2032	No treatment	None	na
89	61	n_410_1	37	2032	No treatment	None	na
98	72	n_410_1	11	2032	No treatment	None	na
103	77	n_410_1	32	2032	No treatment	None	na
120	96	n_410_1	39	2032	No treatment	None	na
90	60	n_410_3	198	2032	Uneven-aged	Underburn	200
113	88	n_410_3	233	2032	Uneven-aged	Pile burn	267
116	91	n_410_3	101	2032	Uneven-aged	Underburn	100
125	101	n_410_3	259	2032	Uneven-aged	Pile burn	267
146	122	n_410_3	97	2032	Uneven-aged	Underburn	100
147	123	n_410_3	143	2032	Uneven-aged	Pile burn	100
171	147	n_410_3	33	2032	Uneven-aged	Underburn	200
173	149	n_410_3	66	2032	Uneven-aged	Underburn	267
185	160	n_410_3	88	2032	Uneven-aged	Pile burn	100
194	167	n_410_3	305	2032	Uneven-aged	Underburn	100
195	168	n_410_3	94	2032	Uneven-aged	Underburn	267
207	179	n_410_3	23	2032	Uneven-aged	Pile burn	200
498	476	n_417_5	57	2032	Uneven-aged	Pile burn	267
514	493	n_417_5	20	2032	Uneven-aged	Pile burn	267
529	506	n_417_5	174	2032	Uneven-aged	Pile burn	267
580	554	n_417_5	5	2032	Uneven-aged	Pile burn	267
584	559	n_417_5	8	2032	Uneven-aged	Pile burn	267
163	141	n_419_1	156	2032	Uneven-aged	Underburn	267
210	1033	n_419_1	192	2032	Uneven-aged	Pile burn	267
227	198	n_419_1	129	2032	Uneven-aged	Pile burn	267
247	182	n_419_1	100	2032	Uneven-aged	Pile burn	267
259	1035	n_419_1	58	2032	Uneven-aged	Pile burn	267
283	261	n_419_1	273	2032	Uneven-aged	Pile burn	267
312	1040	n_419_1	103	2032	Uneven-aged	Pile burn	267
317	1036	n_419_1	137	2032	Uneven-aged	Pile burn	267
318	1038	n_419_1	88	2032	Uneven-aged	Pile burn	267
329	304	n_419_1	48	2032	Uneven-aged	Underburn	267
346	1039	n_419_1	105	2032	Uneven-aged	Pile burn	267
364	338	n_419_1	128	2032	Uneven-aged	Underburn	267
367	289	n_419_1	69	2032	Uneven-aged	Pile burn	267
453	429	n_420_5	78	2032	Uneven-aged	Pile burn	267
492	470	n_420_5	109	2032	Uneven-aged	Pile burn	267
532	509	n_420_5	195	2032	Uneven-aged	Pile burn	267
554	531	n_420_5	118	2032	Uneven-aged	Pile burn	267
576	550	n_420_5	85	2032	Uneven-aged	Pile burn	100
598	576	n_420_5	55	2032	Uneven-aged	Pile burn	267
471	1008	n_421_1	170	2032	Uneven-aged	Pile burn	267
541	448	n_421_1	216	2032	Uneven-aged	Pile burn	267
552	529	n_421_1	105	2032	Uneven-aged	Pile burn	267
571	545	n_421_1	106	2032	Uneven-aged	Pile burn	267
585	561	n_421_1	206	2032	Uneven-aged	Pile burn	267

Stand ID	Plan ID	Mgt. unit	Acres	Modeled treatment year	Management strategy	Modeled fuel treatment	Basal area target (BAT)
599	577	n_421_1	31	2032	Uneven-aged	Pile burn	267
613	1009	n_421_1	77	2032	Uneven-aged	Pile burn	267
616	1010	n_421_1	78	2032	Uneven-aged	Pile burn	267
711	685	n_421_3	227	2032	Uneven-aged	Pile burn	167
727	701	n_421_3	236	2032	Uneven-aged	Pile burn	167
752	726	n_421_3	43	2032	Uneven-aged	Pile burn	267
741	0	n_422_2	66	2032	Uneven-aged	Pile burn	267
743	716	n_422_2	166	2032	Uneven-aged	Underburn	267
745	719	n_422_2	79	2032	Uneven-aged	Pile burn	267
756	730	n_422_2	41	2032	Uneven-aged	Pile burn	267
761	735	n_422_2	128	2032	Uneven-aged	Pile burn	267
792	771	n_422_2	64	2032	Uneven-aged	Pile burn	267
796	776	n_422_2	38	2032	Uneven-aged	Pile burn	267
802	781	n_422_2	53	2032	Uneven-aged	Underburn	267
806	785	n_422_2	202	2032	Uneven-aged	Underburn	267
814	793	n_422_2	85	2032	Uneven-aged	Underburn	267
817	963	n_422_2	70	2032	Uneven-aged	Pile burn	267
497	475	n_bearcr_1	56	2032	Uneven-aged	Underburn	267
520	498	n_bearcr_1	33	2032	Uneven-aged	Underburn	267
524	501	n_bearcr_1	135	2032	Uneven-aged	Underburn	267
530	507	n_bearcr_1	19	2032	Uneven-aged	Underburn	267
546	523	n_bearcr_1	33	2032	Uneven-aged	Underburn	200
556	1046	n_bearcr_1	20	2032	Uneven-aged	Underburn	200
558	534	n_bearcr_1	54	2032	Uneven-aged	Underburn	267
569	1045	n_bearcr_1	77	2032	Uneven-aged	Underburn	200
570	532	n_bearcr_1	22	2032	Uneven-aged	Underburn	200
581	556	n_bearcr_1	49	2032	Uneven-aged	Underburn	200
574	548	n_mckinl_1	80	2032	No treatment	None	na
582	557	n_mckinl_1	144	2032	No treatment	None	na
591	569	n_mckinl_1	97	2032	No treatment	None	na
607	584	n_mckinl_1	47	2032	No treatment	None	na
629	607	n_mckinl_1	28	2032	No treatment	None	na

APPENDIX C – SILVICULTURAL TREATMENT DETAILS

In an effort to manage and understand the complexity of the three modeled alternatives, we are introducing some terminology. The silvicultural details are arranged hierarchically in this section and in our analysis. First, there are three “alternatives”: the proposed action, reduced harvest tree size (30”) and no action. “Alternatives” are defined as different paradigms in managing the KRP landscape. Within each alternative, there may be multiple “management strategies”. A “management strategy” is defined as a major silvicultural paradigm in this analysis and the KRP. Each of the 797 stands is assigned one of the four management strategies for the preferred and reduced harvest tree size alternatives (figure 11; Appendix B). Within each of these management strategies, there are one or more discrete “prescriptions” (figure 11). A “prescription”, in our analysis, is defined as a general silvicultural treatment type. And within each prescription, there may be multiple “specific treatments.” The “specific treatments” differ from prescriptions because they are usually triggered by conditional statements (certain conditions must be met within the simulation unit). There may be multiple prescriptions and multiple specific treatments within each management strategy in order to attain particular goals or because of constraints within the stand (California spotted owl activity center or old forest linkage). Figure 12 shows the management strategies, prescriptions and specific treatments for the proposed action alternative.

Below is a description of each alternative, management strategy within each alternative, prescription within each management strategy and specific treatment within each prescription. Also below, is a description of the global parameters, which are FVS parameters that are independent of alternative, management strategy, prescription or specific treatment and are utilized for all simulations.

As is apparent in Appendix A and B, all of the silvicultural treatments do not occur across the entire landscape at one moment in time; they are spaced out through time starting in 2007 and ending in 2032. Although a large proportion of the landscape will be treated, the treatments are spread out, both spatially and temporally, in an effort to minimize risks to the California spotted owl, fisher and other species.

Figure 11. This figure illustrates how each stand is assigned a management strategy in the proposed action alternative. Note that under each management strategy, there are one or more prescriptions. The underburn only management strategy is not shown here because no stands are assigned this strategy in the providen_1 management unit.

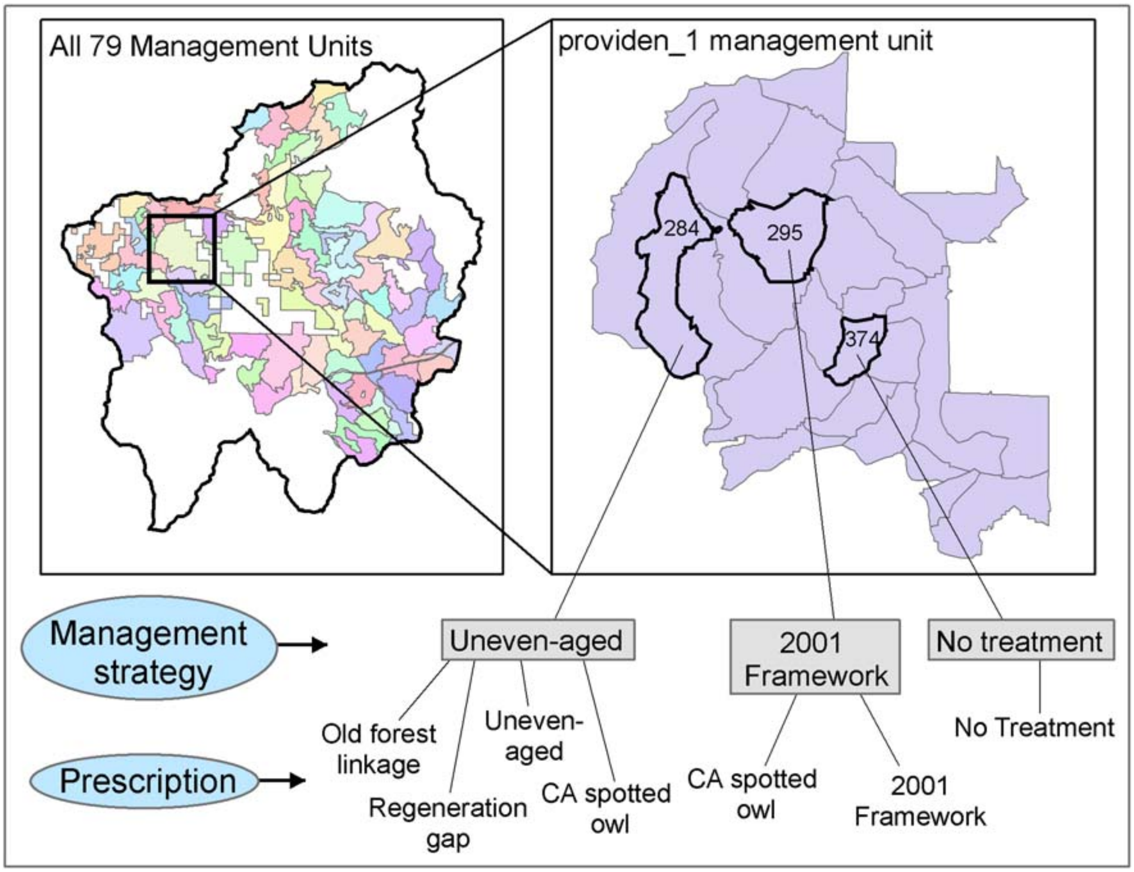
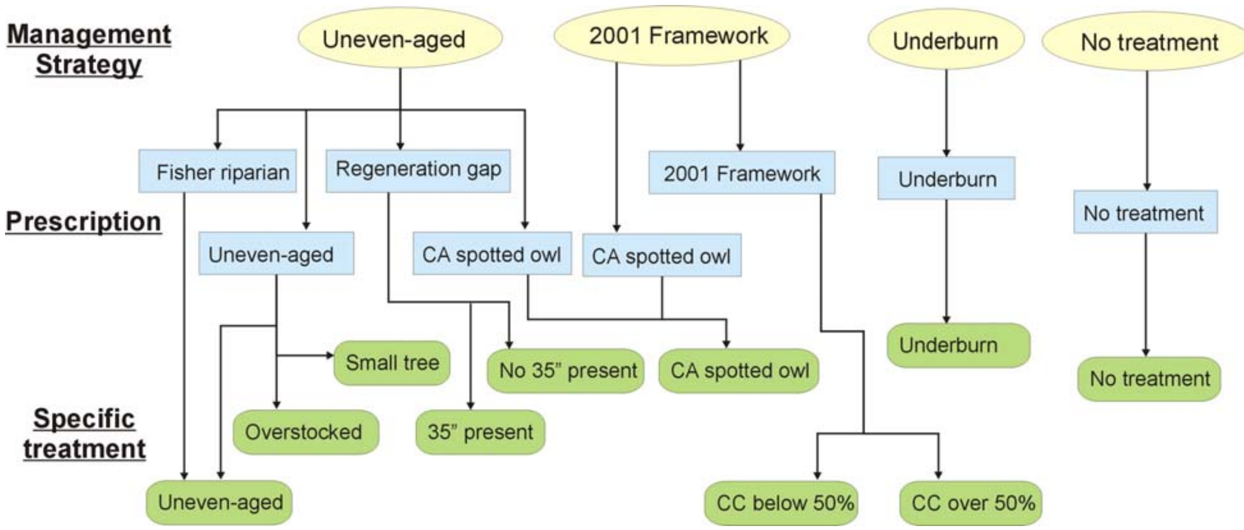


Figure 12. Shows the complexity and hierarchical nature of the proposed action alternative.



PROPOSED ACTION ALTERNATIVE

The proposed action alternative is composed of the uneven-aged, underburn, 2001 Framework (thinning from below) and no treatment management strategies (figure 12). Within these management strategies, there are multiple prescriptions and specific treatments, which are described below. Each stand is assigned a management strategy (Appendix B).

Uneven-aged strategy

The uneven-aged strategy is the dominant management strategy for the proposed action alternative, occurring on 611 stands (Appendix B). The goal of this management strategy is to restore the landscape to pre-1850 conditions, which will reduce the potential for catastrophic wildfire and insect damage, ensure the regeneration of shade-intolerant species, such as ponderosa pine, and preserve the viability of the California spotted owl and other species. Within the uneven-aged management strategy, there are four silvicultural prescriptions: uneven-aged, regeneration gap, old forest linkage and California spotted owl.

Uneven-aged prescription

Within the uneven-aged prescription, there are three specific treatments: uneven-aged, overstocked and small tree. Only one of the three specific treatments is executed in each simulation unit depending upon the vegetation conditions. The uneven-aged specific treatment is executed based on stand conditions, while the overstocked and small tree specific treatments are executed based on simulation unit conditions. In the uneven-aged prescription, simulation units are treated in the initial treatment year shown in Appendix B and are again treated in the same manner 30 years later.

Table 3. Shows the proportion of the basal area target (BAT) in each diameter class.

Diameter class (dbh in inches)	Proportion of BAT in diameter class
0 - 2.9	0.003
3.0 - 4.9	0.01
5.0 - 6.9	0.018
7.0 - 8.9	0.027
9.0 - 10.9	0.035
11.0 - 12.9	0.042
13.0 - 14.9	0.047
15.0 - 16.9	0.051
17.0 - 18.9	0.054
19.0 - 20.9	0.056
21.0 - 22.9	0.056
23.0 - 24.9	0.056
25.0 - 26.9	0.055
27.0 - 28.9	0.053
29.0 - 30.9	0.050
31.0 - 32.9	0.048
33.0 - 34.9	0.045

Uneven-aged specific treatment: In this specific treatment, each stand is assigned a basal area target (BAT), as designated in Appendix B. The basal area target is the desired/expected residual basal area of the stand after treatment. The BAT was determined based on the desired canopy cover of the stand and the dominant tree type (ponderosa pine, red fir, etc.). Because we know the distribution of the desired J-shaped curve, we know the BAT for each two-inch diameter class (see table 3). For example, consider a stand with a BAT of 200 ft^2/acre. Using the information in Table 3, we know that the desired BA in the 17.0 – 18.9" diameter class is 10.8 ft^2/acre (200 ft^2/acre * 0.054).

The uneven-aged specific treatment is quite complex because the desired silvicultural outputs are on the stand scale, but the model is executed at a finer scale (the simulation unit). As a reminder, a stand is composed of many simulation units. To manage the disparity between the stand-based objectives and the simulation unit-based modeling, an extension to FVS was utilized, called the Parallel Processor Extension (PPE) (Crookston and Stage 1991). The PPE, in conjunction with FVS, will conditionally select simulation units for treatment based on stand parameters.

As an example of how the PPE works, let us consider a stand with a basal area target of 200 ft^2/acre. We would not want FVS to cut each simulation unit down to 200 ft^2/acre, because some simulation units have a basal area (BA) below 200 ft^2/acre before treatment. If all simulation units were cut to 200 ft^2/acre, and some were below 200 ft^2/acre before treatment, then the stand would average below 200 ft^2/acre after treatment, which is not the desired output. The PPE will ensure that individual simulation units are treated until the stand-based desired output (in this case a BAT of 200 ft^2/acre) is reached, and then no more simulation units are selected for the uneven-aged specific treatment.

If the PPE determines that a particular simulation unit needs to be treated in order to reach the stand objectives, then FVS will only cut in the diameter classes where there are excesses. This means that only the diameter classes where there is more basal area than is expected (table 3) will be treated. Within FVS, the actual treatment type is a thin from below to a BA target (figure 13). Again, to continue with our example of a BAT of 200 ft^2/acre, using the information in Table 3, FVS will thin from below in the 0 to 2.9" diameter class to a BA of 0.6 ft^2/acre (200 * 0.003), thin from below in the 3.0 to 4.9" diameter class to a BA of 2.0 ft^2/acre (200 * 0.01), thin from below in the 5.0 to 6.9" (200 * 0.018) diameter class to a BA of 3.6 ft^2/acre, etc. For those simulation units selected by the PPE, figure 13 shows the exact treatment as designed and executed in FVS.

The cutting efficiency is defined as the proportion of trees/acre to be removed in any thinning request (Dixon 2003). For simulation units selected by the PPE, the cutting efficiency will always be 1.0 (or 100%) for trees up to 7" dbh (figure 13). However, the cutting efficiency for trees 7" and greater is established using the functions in figure 14. Basically, the cutting efficiency (for trees over 7" dbh) will always be between 0.1 and 0.35 and is dependent upon the relative basal area of differing diameter classes (figure 14).

Overstocked specific treatment: Simulation units that were not selected by the PPE for the uneven-aged specific treatment, but are considered overstocked, receive a specific treatment that is somewhat different. For our purpose, an overstocked simulation unit is defined as having a stand density index (SDI) of greater than 60% of its maximum. To continue with our example of a stand with a BAT of 200, FVS and PPE will treat the simulation units until the stand has a BA of 200 ft^2/acre. If, after this point, there are any untreated simulation units that are overstocked, then those simulation units will be treated in a similar manner as simulation units undergoing the uneven-aged specific treatment. The only difference is that the basal area target will be the higher of either the value in Appendix B or 80% of the pre-treatment basal area.

Small tree specific treatment: For simulation units that are not considered overstocked (the SDI is less than or equal to 60% of its maximum) and are not selected by the PPE for the uneven-aged specific treatment, some small trees are removed. For each 2" diameter class up to 7" dbh, the simulation unit undergoes a thin from below with a residual of 70% of the initial trees. The cutting efficiency is 0.7.

Figure 13. Shows uneven-aged prescription within Suppose. "sBAT" refers to the basal area target (Appendix 2) and "cutprop" refers to the cutting efficiency (figure 14).

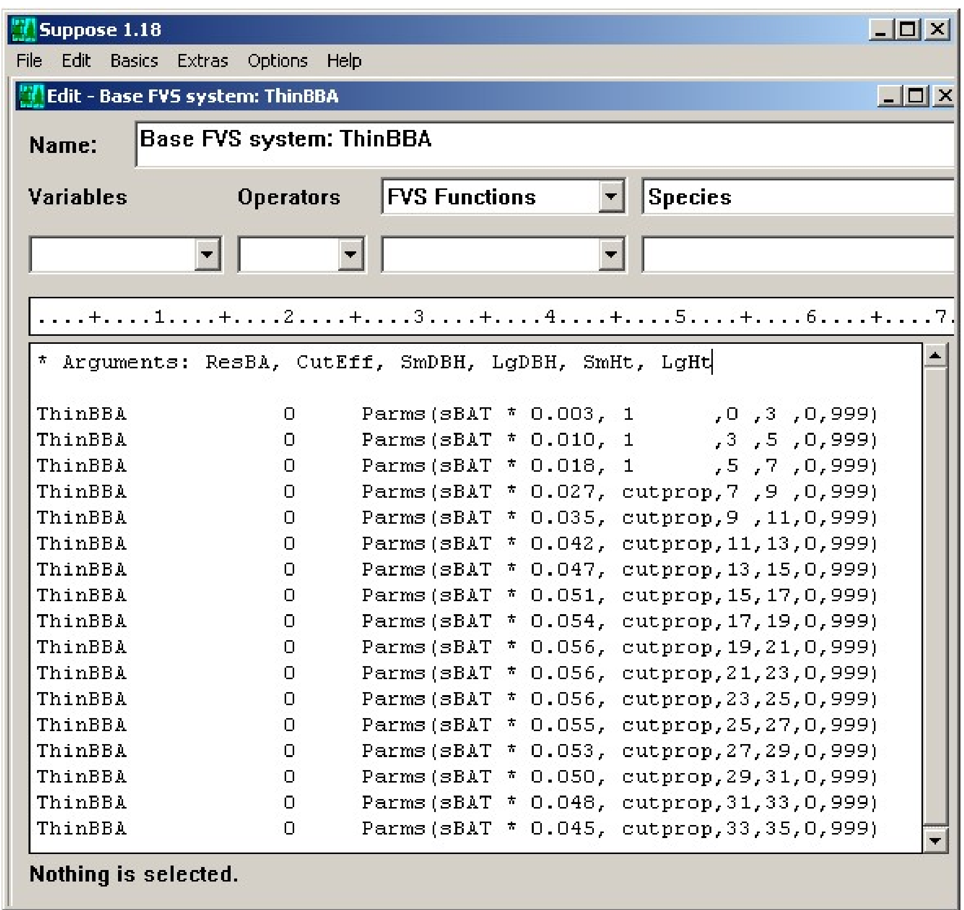


Figure 14. The cutting efficiency (“cutprop”) is determined by the functions in this figure.

```
Compute          0
BAT = Max (sBAT, bba * 0.8)
_bb1 = SpMcDBH (2, All, 0, 11, 17, 0.0, 500.0, 0)
_bb2 = SpMcDBH (2, All, 0, 17, 23, 0.0, 500.0, 0)
_bb3 = SpMcDBH (2, All, 0, 23, 29, 0.0, 500. 0,0)
_bb4 = SpMcDBH (2, All, 0, 29, 35, 0.0, 500.0, 0)
_bal1 = (_bb3 + _bb4) / max ((_bb1 + _bb2), 1)
_bal2 = (_bb1 + _bb2) / max ((_bb3 + _bb4), 1)
_bal = Min (_bal1, _bal2)
cutprop = bound ( .10,  ((_bal) - (.1) + (cycle / 40)), 0 .35)
End
```

Regeneration Gap Prescription

In the uneven-aged management strategy, regeneration gaps are designed provide openings to regenerate shade intolerant species (such as ponderosa pine and black oak) and provide young trees the desired stand structure defined by the inverse J-shaped curve. The regeneration areas compose 10% of the area of each stand. Within the regeneration gap prescription, there are two specific treatments: 35” present and no 35” present. No regeneration gaps are placed within 500 feet of a known California spotted owl activity center or in an old forest linkage. Details of how regeneration gaps were delineated on the landscape are specified in Appendix E.

35” present specific treatment: In the initial treatment year designated in Appendix B, this treatment cuts all trees below 35” dbh and leaves all trees above 35” dbh.

No 35” present specific treatment: If, however, there are no trees above 35” dbh, all trees below 24” dbh will be cut, and a maximum of four trees per acre of trees greater than 24” dbh will be left.

Details about all regeneration gap specific treatments: Ten years after the initial treatment designated in Appendix B, a thin from below leaving 190 trees per acre below 24” dbh and leaving all trees over 24” dbh is modeled. Thirty years after the initial treatment, the simulation units are treated using the uneven-aged specific treatment (figure 13), with one difference: all cutting efficiencies labeled with “cutprop” are converted to 0.8. After the initial treatment, if more than 30% of the basal area was removed and the simulation unit is below 6000 feet elevation, the model simulated the planting of 176 ponderosa pine, 70 sugar pine and 91 white fir per acre. If the simulation unit is above 6000 feet elevation and more than 30% of the basal area was removed, the model simulated the planting of 136 Jeffrey pine, 50 white fir and 91 red fir per acre. An additional 25 incense cedar per acre are naturally established every ten years for all simulation units below 6000 feet elevation.

Old Forest Linkage Prescription

Old forest linkages were set up near rivers and streams to aid fishers in movement and dispersal. These areas have a separate prescription, which is very similar to that of the uneven-aged specific treatment. The only difference is that the basal area target is not the value listed in Appendix B, but is either 207 or 267 ft^2/acre depending on the relative density of the fir (red and white) component in the simulation unit. If the fir basal area is greater than or equal to10% of the simulation unit's total BA, then the BAT is 267 ft^2/acre. Otherwise, the BAT is 207 ft^2/acre.

California Spotted Owl Prescription

If there is a California spotted owl activity center within a particular stand, then all areas within a 500 foot radius are treated differently. This is a simple prescription, and involves the removal of 75% of the basal area in all trees 6" dbh and less.

Underburn Only Management Strategy

As shown in Appendix B, there are 34 stands that undergo the underburn only management strategy. The underburn only management strategy consists of three separate underburns. The underburns are modeled three, seven and fifteen years after the year specified in Appendix B. For each underburn, the model parameters are as follow:

a. 1-hour fuels (0 – 0.25"): 7% moisture content
b. 10-hour fuels (0.25" – 1"): 8% moisture content
c. 100-hour fuels (1" – 3"): 10% moisture content
d. 1000-hour fuels (3"+): 100% moisture content
e. Duff: 125% moisture content
f. Live woody fuels: 150% moisture content
g. Live herb fuels: 150% moisture content
h. Temperature: 70º Fahrenheit
i. Wind speed: 5 mph
j. Percentage of stand area burned: 70%

2001 Framework Management Strategy (Thinning from Below)

This set of prescriptions is a best-attempt to mimic the management strategy described in the 2001 framework record of decision (USDA Forest Service 2001). The 2001 framework strategy (thinning from below) is modeled on 38 stands (Appendix B). This management strategy occurs within California spotted owl protected activity centers that are part of the California spotted owl study. In the 2001 Framework management strategy (thinning from below), there are two silvicultural prescriptions: 2001 Framework and California spotted owl.

2001 Framework Prescription

Within the 2001 Framework prescription, there are two specific treatments: CC over 50% and CC below 50%.

CC over 50% specific treatment: If the average canopy cover of the stand exceeds 50%, then simulation units in the stand with more than 50% canopy cover are thinned from below (only trees less than 20" dbh) to a residual canopy cover of 50%. The parallel processing extension was again utilized for this prescription: simulation units are only treated until the stand canopy cover reaches 50%. However, because the PPE does not operate on stand-based canopy cover (it operates on stand-based basal area), we estimated the residual basal area needed to attain a residual canopy cover of 50%, and the PPE uses that estimated basal area target to determine if individual simulation units need to be treated to attain our goal of 50% canopy cover.

CC below 50% specific treatment: If the average canopy cover in the stand is less than 50%, or if any individual simulation unit has a canopy cover of less than 50%, then the simulation units are thinned from below to a residual of 250 trees per acres (TPA) in the 0 – 6” dbh range (no trees above 6” dbh are cut).

California Spotted Owl Prescription

If there is a California spotted owl activity center within a particular stand, then all areas within a 500 foot radius are treated differently. This is a simple prescription, and involves the removal of 75% of the basal area in all trees 6” dbh and less.

No Treatment Management Strategy

Under this management strategy, we simply use FVS model natural growth with no silvicultural or fuels treatments. Appendix B lists the 114 stands that receive the no treatment management strategy.

REDUCED HARVEST TREE SIZE (30”) ALTERNATIVE

The reduced harvest tree size alternative was created to account for diameter limit recommendations made in the Sierra Nevada Forest Plan Amendment, Final Supplemental Environmental Impact Statement, Record of Decision (USDA Forest Service 2004). The reduced harvest tree size is composed of the modified uneven-aged, underburn, 2001 Framework (thinning from below) and no treatment management strategies. Within these management strategies, there are multiple prescriptions and specific treatments, which are described below. This alternative is very similar to the proposed alternative, so this description is less detailed than the proposed alternative.

Modified uneven-aged strategy

The modified uneven-aged strategy is the dominant management strategy for the reduced harvest tree size alternative, occurring on 611 stands. The goal of this management strategy is to restore the landscape to pre-1850 conditions, which will reduce the potential for catastrophic wildfire and insect damage, ensure the regeneration of shade-intolerant species, such as ponderosa pine, and preserve the viability of the California spotted owl and other species. Within the modified uneven-aged management strategy, there are four silvicultural prescriptions: modified uneven-aged, modified regeneration gap, modified old forest linkage and California spotted owl.

Modified Uneven-aged prescription

Within the modified uneven-aged prescription, there are three specific treatments: modified uneven-aged, modified overstocked and small tree. Only one of the three specific treatments is executed in the model depending upon the vegetation conditions. The uneven-aged specific treatment is executed based on stand conditions, while the overstocked and small tree specific treatments are executed based on simulation unit conditions. In the modified uneven-aged prescription, simulation units are treated in the initial treatment year shown in Appendix B and are again treated in the same manner 30 years later.

Modified uneven-aged specific treatment: This specific treatment is exactly the same as that described in the proposed alternative, with one difference: no trees over 30” are cut. Refer to the description of the uneven-aged specific treatment in the proposed action for details.

Modified overstocked specific treatment: This specific treatment is exactly the same as that described in the proposed alternative, with one difference: no trees over 30” are cut. Refer to the description of the overstocked specific treatment in the proposed action for details.

Small tree specific treatment: This specific treatment is exactly the same as that described in the proposed alternative.

<u>Modified Regeneration Gap Prescription</u>

In the uneven-aged management strategy, regeneration gaps are designed provide openings to regenerate shade intolerant species (such as ponderosa pine and black oak) and provide young trees the desired stand structure defined by the reverse J-shaped curve. The regeneration areas compose 10% of the area of each stand. Within the regeneration gap prescription, there are two specific treatments: 30” present and no 30” present. No regeneration gaps are placed within 500 feet of a known California spotted owl activity center or in an old forest linkage. Details of how regeneration gaps were delineated on the landscape are specified in Appendix E.

30” present specific treatment: In the initial treatment year designated in Appendix B, this treatment cuts all trees below 30” dbh and leaves all trees above 30” dbh.

No 30” present specific treatment: If, however, there are no trees above 30” dbh, all trees below 24” dbh will be cut, and a maximum of four trees per acre of trees greater than 24” dbh will be left.

Details about all regeneration gap specific treatments: This is exactly the same as that described in the proposed alternative.

<u>Modified Old Forest Linkage Prescription</u>

Old forest linkages were set up near rivers and streams to aid fishers in movement and dispersal. This prescription is very similar to that described in the proposed action alternative, the only difference being that no trees over 30” dbh are cut.

<u>California Spotted Owl Prescription</u>

If there is a California spotted owl activity center within a particular stand, then all areas within a 500 foot radius are treated differently. This is a simple prescription, and involves the removal of 75% of the basal area in all trees 6” dbh and less.

Underburn Only Management Strategy

As shown in Appendix B, there are 34 stands that undergo the underburn only management strategy. This management strategy is exactly as that of the proposed action alternative.

2001 Framework Management Strategy (Thinning from Below)

The 2001 management strategy (thinning from below) and its associated prescriptions and specific treatments is exactly as that of the proposed action alternative. This management strategy occurs within California spotted owl protected activity centers that are part of the California spotted owl study. Appendix B lists the 38 stands that receive the 2001 Framework management strategy (thinning from below).

No Treatment Management Strategy

Under this management strategy, we simply use FVS to model natural growth with no silvicultural treatment. Appendix B lists the 114 stands that receive the no treatment management strategy.

NO ACTION ALTERNATIVE

Under the no action alternative, we simply use FVS model the natural growth of all simulation units with no silvicultural or fuels treatments.

GLOBAL PARAMETERS

The following parameters are considered “global parameters”, because they are utilized for all simulation units and are independent of management strategy, prescription or specific treatments.

Regeneration

Table 4 describes the regeneration conditions, number of trees and the species’ involved. This applies to all simulation units except those that undergo the regeneration gap prescription.

Table 4. Parameters for regeneration.

Condition 1		Condition 2		Result	Timing
fir component >= 15% of total BA	**and**	removal > 20% total BA **or** mortality > 20 ft^3/acre/year	**then**	20 ponderosa pine/acre 10 sugar pine/acre 20 white fir/acre	8 years after conditions are met
fir component < 15% total BA	**and**	removal > 20% total BA **or** mortality > 20 ft^3/acre/year	**then**	40 ponderosa pine/acre 10 sugar pine/acre	8 years after conditions are met
elevation is below 6000 feet			**then**	25 incense cedar/acre	every 10 years

Other Parameters

1) Removal preferences by dwarf mistletoe rating (DMR) were set as follows:
    a. 0 for DMR = 0
    b. 2000 for DMR = 2
    c. 3000 for DMR = 3
    d. 4000 for DMR = 4
    e. 5000 for DMR = 5
    f. 6000 for DMR = 6
2) Black oak sprouting was set to 0.25.
3) Black oak has a removal preference of –200.
4) Incense cedar has a removal preference of 100.
5) Volume estimates do not include black oak.
6) Defect proportion for red fir was set as follows for different tree dbh sizes:
    a. 5” = 0%
    b. 10” = 0%
    c. 15” = 10%
    d. 20” = 10%
    e. 25” = 15%
    f. 30” = 15%
    g. 35” = 20%
    h. 40”+ = 25%
7) Defect proportion for white fir was set as follows for different tree dbh sizes:
    a. 5” = 0%
    b. 10” = 0%
    c. 15” = 0%
    d. 20” = 0%
    e. 25” = 5%
    f. 30” = 15%
    g. 35” = 15%
    h. 40”+ = 15%
8) The “statfuel” keyword is utilized so that only one fuel model is used to calculate fire intensity.
9) Other global parameters involving the FFE-FVS are discussed in Appendix D – Fire and Fuels Extension.

Canopy cover equation modification

There are many methods for determining canopy cover of forested areas. There are direct field-based methods, such as utilizing instruments like a densiometer or moosehorn. Canopy cover can also be estimated using aerial photography or calculated using equations, assumptions and plot data. Unfortunately, all of these methods do not yield the same results (Landram 2002), making comparisons between the methods difficult and biased.

Appendix B of the Sierra Nevada Forest Plan Amendment - Final Supplemental Environmental Impact Statement (USDA Forest Service 2004), states that canopy cover interpreted from aerial photography should be the basis for determining canopy cover. Furthermore, this document states that other methods of determining canopy cover must be calibrated to that of photo interpreted canopy cover.

Landram (2002) undertook a study within the KRP area to determine the differences in the canopy cover values of aerial photography interpretation compared to that of field-based methods and plot data calculations. He also developed calibration equations to convert field and plot-based calculations to match that of photo interpreted canopy cover values. Generally, the plot-based canopy cover calculations underestimated canopy cover compared to photo interpreted values. Collins and Woodcock (circa 1995) conducted a similar study on the Lassen and Modoc National Forests and had similar findings.

Because we are using plot data, and hence are calculating canopy cover based on these plot data, we decided to convert the plot-based canopy cover values to values that would more reflect canopy cover values obtained from photo interpretation. We used the equation from Landram (2002) to convert these values. All CWHR density classes, and hence the habitat assessments for the fisher and California spotted owl, utilize the modified canopy cover values. Both the corrected and uncorrected canopy cover values are in the output databases. The equation is as follows:

Predicted photo interpreted canopy cover (percent) = -2 + 1.23 (plot-based canopy cover)

This approach is very similar to that utilized in Appendix B the Sierra Nevada Forest Plan Amendment (USDA Forest Service 2004) convert from plot-based canopy cover to that of aerial photo interpretation; the conversion equation is slightly different.

APPENDIX D – FIRE AND FUELS EXTENSION

The Fire and Fuels Extension to FVS (FFE-FVS) (Reinhardt and Crookston 2003) is a model that simulates fuel dynamics and potential fire behavior over time (Beukema et al. 2003). We used the FFE-FVS for the following operations:

1) Generate information about potential fire fuel conditions
2) Simulate a severe wildfire for each scenario
3) Simulate fuels treatment (underburn, pile burn, gross yard)
4) Specify fuel model under certain conditions

Fire reports were generated for both a potential moderate and severe fire. This is a *potential* fire and outputs variables that are related to fire threat and intensity; this is not simulating a fire. The output variables (Appendix G) in these reports are useful to determine severity of fire threat among the different scenarios. Additionally, because the output from this model maintains the spatial component, some of the output variables from the potential fire reports will be utilized in a fire behavior models such as FARSITE (Finney 1998) or FlamMap (Finney In Press). These variables include crown bulk density, crown height and others. The parameters input into FFE-FVS for the potential fire reports are detailed in table 5.

The FFE-FVS was also utilized to simulate a severe wildfire. This actually simulates a wildfire, and FFE-FVS changes the vegetation structure and composition to reflect the predicted changes that a severe fire would cause. Simulation of the severe wildfire was carried out in order to compare fire severity between the three scenarios. We realize that it is not likely that the entire KRP landscape will burn during one fire event, but the results of this simulation serve as an index of resistance to severe fires. The severe fire was simulated in 2015, and the parameters input into FFE-FVS are detailed in table 5.

Table 5. Environmental parameters for the potential fire reports and the severe fire in 2015.

Variable	**Potential fire report: moderate fire**[a]	**Potential fire report: severe fire**[a]	**Simulated severe fire in 2015**[b]
1-hour fuels (0 – 0.25”) (% moisture content)	12	3	3
10-hour fuels (0.25” – 1”) (% moisture content)	12	4	4
100-hour fuels (1” – 3) (% moisture content)	14	5	5
1000-hour fuels (3”+) (% moisture content)	25	7	15
Duff (% moisture content)	125	10	75
Live woody vegetation (% moisture content)	150	80	80
Live herb vegetation (% moisture content)	150	4	4
Temperature (ºF)	82	95	92
20-foot wind speed (mph)	10	20	20
Stand area burned (%)	100	70	100/70 [c]

[a] The potential fire report, for both a moderate and severe fire, is generated for the three scenarios. This is a *potential* fire and a fire is not simulated.

[b] The environmental parameters for the severe fire in 2015. This fire is simulated throughout all simulation units.

[c] The percent of stand areas burned was 100% for the no action alternative and 70% for the proposed and reduced harvest tree size alternatives. These values differ because our experience informs us that, if a stand is treated, then the entire stand is not affected by a severe fire.

The FFE-FVS was also utilized to simulate fuels treatments, including underburn, gross yard and pile burn treatments. Details for these activities can be viewed in the main document.

Finally, the FFE-FVS was utilized to define the conditions for when a particular fuel model (FM) will be utilized. The choices for fuel models 5, 8, 10 and 26 were customized to reflect the existing stand structures and the effects of treatments on stand structure. Existing stand conditions with significant understory vegetation and multi-layered structures with greater than 40% canopy cover are better represented by FM-10. While treatments to reduce canopy layering, brush cover, and height to live crown result in vegetation structures represented by the open timber conditions in FM-8. The conditions under which the fuel model is defined are as follow:

FM-8) Assign FM-8 five years after the following conditions are met →

a. the simulation unit has been treated
b. the residual QMD of all trees greater than 6" dbh exceeds 11" dbh
c. the residual canopy cover for all trees greater than 6" dbh exceeds 25%
d. the forest type is not California black oak

→ 25 years after the above conditions have been met, FVS will choose a fuel model based on the default decisions of the FFE-FVS. After 25 years, FFE-FVS' default choices for fuel models will better reflect conditions. Experience and literature indicate that treatment effects will last up to 15 to 25 years. Additional maintenance treatments prolong open stand conditions described by FM-8

FM-10) Assign FM-10 when the following conditions are met →

a. the simulation unit has not been treated
b. the BA of all trees between 0 and 7" dbh is greater than 5 ft^2/acre
c. the residual canopy cover for all trees greater than 6" dbh exceeds 40%
d. the QMD of all trees greater than 6" dbh exceeds 11" dbh

→ 20 years after the above conditions have been met, FVS will choose a fuel model based on the default decisions of the FFE-FVS.

FM-5) Assign FM-5 when the following conditions are met →

a. the simulation unit has not been treated
b. the fir component is between 15 and 75% of the simulation unit BA
c. the canopy cover for all trees greater than 6" dbh is between 25 and 40%
d. the QMD of all trees greater than 6" dbh exceeds 11" dbh

→ 20 years after the above conditions have been met, FVS will choose a fuel model based on the default decisions of the FFE-FVS.

FM-26) Assign FM-26 when the following conditions are met →

a. the simulation unit has not been treated
b. the fir component is less than 15% of the simulation unit BA
c. the canopy cover for all trees greater than 6" dbh is between 25 and 40%
d. the QMD of all trees greater than 6" dbh exceeds 11" dbh

→ 20 years after the above conditions have been met, FVS will choose a fuel model based on the default decisions of the FFE-FVS.

APPENDIX E – GIS DATA PREPARATION / DELINEATION OF SIMULATION UNITS

Below are the steps that were taken in order to define the simulation units, including the creation/modeling of regeneration areas. These steps involve basic GIS operations and complex *avenue* scripts

1) The original vegetation GIS layer obtained from Ramiro Rojas (asvg_97up996) has 8,641 polygons. However, some adjacent polygons have the same WHR type, size and density. The adjacent polygons in this layer with the same WHR type, size and density are "dissolved" together. The resultant vegetation layer has 7,625 polygons and is named "revised_kras_veg.shp".

2) The revised vegetation layer described in step 1 was intersected with the stand boundary layer. The purpose of this step was to ensure that vegetation polygons that spanned across stand boundaries were clipped so that the vegetation polygon matched the boundary of the stand.

3) The intersection described in step 2 created many very small polygons (sliver polygons). A minimum mapping unit of 0.5 acres is implemented. Any polygon under 0.5 acres is merged with the polygon with the same vegetation ID (meaning it is merged with the polygon it was split from). If a polygon smaller than 0.5 acres is adjacent to two polygons with the original vegetation ID (it was split into three polygons by the stand intersection), then it is merged with the polygon with the longest common edge. If a polygon was less than 0.5 acres in the original vegetation layer (mostly water features), then it was left as-is. Sliver polygons not created by the intersection process, but were part of the original vegetation layer by Ramiro, were merged with an adjacent polygon most similar to the sliver polygon.

4) For stands that are to be treated mechanically, 10% of the area in those stands is designated as regeneration areas. A custom script was created in ArcView GIS (ESRI Inc. 2000) to account for these regeneration areas. Because there is no knowledge about where these will be placed, the location of these regeneration gaps is modeled. The spatial locations of these modeled regeneration gaps are most likely incorrect due to the stochastic nature of the model, but should provide a realistic representation of their spatial distribution. The vegetation types in which these regeneration areas are placed should also be correct. To model the regeneration gaps, the model works as follows:
    a. The preferred vegetation type is selected.
    b. A random point is placed in the selected vegetation type.
    c. The point is buffered 30 meters, which corresponds to 0.7 acres.
    d. The buffered point is then clipped to the polygon in which it fell.
    e. The point is iteratively buffered and clipped until whichever happens first: the polygon reaches 3 acres in size, the entire vegetation polygon is consumed by the regeneration polygon, or the regeneration areas equal 10% of the stand area.
    f. If all regeneration polygons do not equal 10% of the stand area, the go back to step a.

Priority for regeneration areas are as follow:

I. No regeneration placed in plantations, or polygons with a WHR type of MHW, BOW or MHC (except MHC in step G).
II. Areas of montane chaparral (MCP)
III. Size class 3, 4 or 5 with a density of “S”.
IV. Size class 3, 4 or 5 with a density of “P”.
V. Size class 3, 4 or 5 with a density of “M”.
VI. Size class 3, 4 or 5 with a density of “D”.
VII. Size class 3, 4 or 5, any density and WHR type of MHC.

The final product is a GIS layer (“group_selections.shp”) depicting the locations of the regeneration gaps.

5) GIS layers depicting regeneration gaps, California spotted owl buffers and old forest linkages were then “intersected” with the layer described in step two.

6) The intersection described in step 5 created many very small polygons (sliver polygons). A minimum mapping unit of 0.5 acres is implemented. Any polygon under 0.5 acres is merged with the polygon with the same vegetation ID (meaning it is merged with the polygon it was split from). If a polygon smaller than 0.5 acres is adjacent to two polygons with the original vegetation ID (it was split into three polygons by the stand intersection), then it is merged with the polygon with the longest common edge. This action results in a layer named “final_su1.shp”.

7) Because of the actions taken in step 2, some of the stand boundaries shifted slightly. These changes in the stand boundary are negligible and worth reducing the number of polygons. All polygons with the same stand ID were dissolved, creating “revised_stands_012005.shp”. So now the stand boundaries follow vegetation boundaries, or vice versa.

APPENDIX F – MOST SIMILAR NEIGHBOR

The Forest Vegetation Simulator uses vegetation plot data to project vegetation into the future. In order to use FVS to model all simulation units, it is necessary to assign representative plot data to uninventoried simulation units. To carry out this task, a program named Most Similar Neighbor (MSN) (Moeur and Stage 1995; Crookston et al. 2002) was utilized. MSN is a statistical program that uses canonical correlation analysis to utilize relationships between the plot-based vegetation variables and GIS-based variables. The MSN program outputs which inventoried simulation units are "most similar" to the uninventoried simulation units. Below are the steps we took to implement the MSN program.

1) For the use of Most Similar Neighbor (MSN), GIS-based variables available for each simulation unit are calculated. The GIS-based variables are shown in table 6. The average value for these variables in each simulation unit is calculated using "zonal statistics" in ArcView GIS (ESRI Inc. 2000) or ArcMap (ESRI Inc. 2002). Within MSN, these variables are called the "x-variables". X-variables, also called environmental variables, are available for every simulation unit.

2) Many of the x-variables shown in table 6 are highly correlated. All variables with a correlation coefficient higher than 0.9 were removed from the MSN analysis. Additionally, any variables that we believed to cause MSN to run poorly were removed from the analysis.

Table 6. List of the x-variables (variables available across the entire project area) and the y-variables (only available for simulation units where plots are located). Those variables identified with a ** were not used in the MSN analysis.

X-Variables	**Y-Variables**
Elevation	Canopy cover of small trees (0 - 4.9" dbh)
Slope	Canopy cover of medium trees (5 - 19.9" dbh)
Heat load index (McCune and Keon 2002)	Canopy cover of large trees (> 20" dbh)
Potential solar radiation (McCune and Keon 2002)	Canopy cover of trees over 6" dbh
Slope-aspect transformation (sin)	Canopy cover of tree 11-24" dbh
Slope-aspect transformation (cos)	Canopy cover of trees over 24" dbh
Compound topographic index	Total Canopy cover
** Landform index (McNab 1993)	** Trees per acre
** TM band 1	Basal area per acre
TM band 2	Top height (Avg. height of 40 largest-dbh trees/acre)
TM band 3	** Total volume
TM band 4	** Mortality (ft3/year)
TM band 5	** Basal area of ponderosa pine
** TM band 7	** Basal area of white fir
** Brightness (Crist and Cicone 1984)	** Basal area of incense cedar
** Greenness (Crist and Cicone 1984)	** Basal area of red fir
Wetness (Crist and Cicone 1984)	** Basal area of black oak
NDVI	** Basal area of sugar pine
DOQ value	** Basal area of pole trees
Northing	** Basal area of saw trees
Easting	Trees per acre of small trees (0 - 4.9" dbh)
Northing x easting	Trees per acre of large trees (> 16" dbh)
CWHR size class (from GIS)	Quadric mean diameter
CWHR density class (from GIS)	Quadratic mean diameter of trees over 6" dbh

3) MSN finds relationships between the x-variables and the plot-derived variables, which are only available in the simulation units which plots were located. The plot data is entered into FVS and “compute” statements are executed to extract key information from the plot data. The key information extracted from the plot data are called “y-variables” and are shown in table 6.

4) Many of the y variables described in step 3 are highly correlated. All variables with a correlation coefficient higher than 0.9 were removed from the MSN analysis. Additionally, many of the variables had a large number of zeros (variable of interest was not detected), which were removed from the MSN analysis.

5) MSN is then run with the x and y variables shown in table 6. MSN finds relationships between the x and y variables using canonical correlation analysis. Then, for the simulation units without plot data, MSN identifies the simulation unit with plot data that is “most similar” to the simulation unit without plot data.

6) Once the most similar neighbor has been identified, the simulation unit without plot data is assigned the plot data from the simulation unit designated as its most similar neighbor. The plot data text file was altered and appended to incorporate the output of MSN by creating a custom *Avenue* script in ArcView GIS (ESRI Inc. 2000).

7) FVS can now be utilized for each simulation unit of interest.

APPENDIX G – DESCRIPTION OF OUTPUT VARIABLES

Description of the "TREE_variables" query

1. SU_ID: Identification for simulation unit. Use this field to join with GIS file "KRP_su.shp".
2. Year: year variables are computed
3. Stand_ID: Sean Parks' stand identification
4. Plan_ID: Ramiro Rojas' stand identification
5. Project: project name
6. bcc0_20: canopy cover (% cover) of trees from 0-20" dbh before any treatments
7. acc0_20: canopy cover (% cover) of trees from 0-20" dbh after any treatments
8. bcc20up: canopy cover (% cover) of trees over 20" dbh before any treatments
9. acc20up: canopy cover (% cover) of trees over 20" dbh after any treatments
10. bcc6up: canopy cover (% cover) of trees over 6" dbh before any treatments
11. acc6up: canopy cover (% cover) of trees over 6" dbh after any treatments
12. bcc1124: canopy cover (% cover) of trees 11-24" dbh before any treatments
13. acc1124: canopy cover (% cover) of trees 11-24" dbh after any treatments
14. bcc24up: canopy cover (% cover) of trees over 24" dbh before any treatments
15. acc24up: canopy cover (% cover) of trees over 24" dbh after any treatments
16. bstdcc: canopy cover (% cover) of all trees before any treatments
17. astdcc: canopy cover (% cover) of all trees after any treatments
18. nbcc0_20: unadjusted canopy cover of trees from 0-20" dbh before treatments
19. nacc0_20: unadjusted canopy cover of trees from 0-20" dbh after any treatments
20. nbcc20up: unadjusted canopy cover of trees over 20" dbh before any treatments
21. nacc20up: unadjusted canopy cover of trees over 20" dbh after any treatments
22. nbcc6up: unadjusted canopy cover of trees over 6" dbh before any treatments
23. nacc6up: unadjusted canopy cover of trees over 6" dbh after any treatments
24. nbcc1124: unadjusted canopy cover of trees 11-24" dbh before any treatments
25. nacc1124: unadjusted canopy cover of trees 11-24" dbh after any treatments
26. nbcc24up: unadjusted canopy cover of trees over 24" dbh before any treatments
27. nacc24up: unadjusted canopy cover of trees over 24" dbh after any treatments
28. nbstdcc: unadjusted canopy cover (% cover) of all trees before any treatments
29. nastdcc: unadjusted canopy cover (% cover) of all trees after any treatments
30. bsng515: before any treatments, number of snags per acre 5-15" dbh
31. bsng1524: before any treatments, number of snags per acre 15-24" dbh
32. bsng2435: before any treatments, number of snags per acre 24-35" dbh
33. bsng35up: before any treatments, number of snags per acre over 35" dbh
34. btheight: top height before any treatments
35. atheight: top height after any treatments
36. bqmd: quadratic mead diameter before any treatments
37. aqmd: quadratic mead diameter after any treatments
38. bqmd6up: quadratic mead diameter of trees over 6" dbh before any treatments
39. aqmd6up: quadratic mead diameter of trees over 6" dbh after any treatments
40. b_ba: basal area (ft^2/acre) before any treatments
41. a_ba: basal area (ft^2/acre) after any treatments
42. b_bf: total board feet before any harvest

43. cut_bdft: harvested board feet per acre
44. a_bf: total board feet after any harvest
45. b_vol: merchantable cubic foot volume per acre before any treatments
46. cut_vol: harvested merchantable cubit foot per acre
47. a_vol: merchantable cubic foot volume per acre after any treatments
48. tpaseed: number of trees per acre in the 0-1” size class before any treatments
49. tpa02: number of trees per acre in the 1-3” size class before any treatments
50. tpa04: number of trees per acre in the 3-5” size class before any treatments
51. tpa06: number of trees per acre in the 5-7” size class before any treatments
52. tpa08: number of trees per acre in the 7-9” size class before any treatments
53. tpa10: number of trees per acre in the 9-11” size class before any treatments
54. tpa12: number of trees per acre in the 11-13” size class before any treatments
55. tpa14: number of trees per acre in the 13-15” size class before any treatments
56. tpa16: number of trees per acre in the 15-17” size class before any treatments
57. tpa18: number of trees per acre in the 17-19” size class before any treatments
58. tpa20: number of trees per acre in the 19-21” size class before any treatments
59. tpa22: number of trees per acre in the 21-23” size class before any treatments
60. tpa24: number of trees per acre in the 23-25” size class before any treatments
61. tpa26: number of trees per acre in the 25-27” size class before any treatments
62. tpa28: number of trees per acre in the 27-29” size class before any treatments
63. tpa30: number of trees per acre in the 29-31” size class before any treatments
64. tpa32: number of trees per acre in the 31-33” size class before any treatments
65. tpa34: number of trees per acre in the 33-35” size class before any treatments
66. tpa99: number of trees per acre over 35” dbh before any treatments
67. tpa0_10: number of trees per acre in the 0-10” size class before any treatments
68. tpa10_20: number of trees per acre in the 10-20” size class before any treatments
69. tpa_20_30: number of trees per acre in the 20-30” size class before any treatments
70. tpa30_35: number of trees per acre in the 30-35” size class before any treatments
71. tpa35up: number of trees per acre over 35” dbh before any treatments
72. ba_0_10: basal area (ft^2/acre) in the 0-10” size class before any treatments
73. ba10_20: basal area (ft^2/acre) in the 10-20” size class before any treatments
74. ba_20_30: basal area (ft^2/acre) in the 20-30” size class before any treatments
75. ba30_35: basal area (ft^2/acre) in the 30-35” size class before any treatments
76. ba35up: basal area (ft^2/acre) of trees over 35” dbh before any treatments
77. ba_sp: basal area of sugar pine before any treatments
78. ba_wf: basal area of white fir before any treatments
79. ba_ic: basal area of incense cedar before any treatments
80. ba_bo: basal area of black oak before any treatments
81. ba_pp: basal area of ponderosa pine before any treatments
82. ba_rf: basal area of red fir before any treatments
83. b_cwhr: CWHR size and density before any treatments
84. a_cwhr: CWHR size and density after any treatments
85. Acres: Area of simulation unit

Description of the "FIRE_variables" query

1. SU_ID: Identification for simulation unit. Use this field to join with GIS file "KRP_su.shp".
2. Year: year variables are computed
3. Stand_ID: Sean Parks' stand identification
4. Plan_ID: Ramiro Rojas' stand identification
5. Project: project name
6. Surf_flame_sev: Surface fire flame length (feet) under severe conditions
7. Surf_flame_mod: Surface fire flame length (feet) under moderate conditions
8. Tot_flame_sev: Total flame length (feet) under severe conditions
9. Tot_flame_mod: Total flame length (feet) under moderate conditions
10. Fire_type_sev: Type of fire (surface, passive, conditional surface* or active crown) under severe conditions
11. Fire_type_mod: Type of fire (surface, passive, conditional surface* or active crown) under moderate conditions
12. PTorch_sev: the proportion of small places where torching is possible under severe conditions
13. PTorch_mod: the proportion of small places where torching is possible under moderate conditions
14. Torch_index**: The 20-ft wind speed (miles/hour) required to cause torching of some trees under severe conditions
15. Crown_index**: The 20-ft wind speed (miles/hour) required to cause an active crown fire under severe conditions
16. Canopy_HT**: The height (feet) of the base of the canopy
17. Canopy_Density: The bulk density of the canopy (Kg/m^3)
18. Mortality_BA_Sev: Percent of the basal area that would be killed under severe conditions
19. Mortality_BA_Mod: Percent of the basal area that would be killed under moderate conditions
20. Mortality_Vol_Sev: Total volume (cubic feet) that would be killed under severe conditions
21. Mortality_Vol_Mod: Total volume (cubic feet) that would be killed under moderate conditions
22. Pot_Smoke_Sev: The potential amount of smoke emissions (tons/acre) less than 2.5 microns under severe conditions
23. Pot_Smoke_Mod: The potential amount of smoke emissions (tons/acre) less than 2.5 microns under moderate conditions
24. Fuel_Model: The fire behavior fuel model
25. Acres: Area of simulation unit.

* A conditional surface fire is predicted when the windspeed is greater than the crowning index, but less than the torching index (Scott and Reinhardt 2001). The interpretation is that if a fire originates as a surface fire in the stand, it is expected to remain so. If a fire originates as an active crown fire in an adjacent stand, active crown fire will continue through the stand.

** Values of "-1" are present for canopy base height, torching index and crowning index if canopy fuels are so sparse that the canopy base height is undefined.

Description of the "CWHR_fisher" query

This query contains CWHR habitat information for the fisher.

1. SU_ID: Identification for simulation unit. Use this field to join with GIS file "KRP_SU.shp".
2. Year: year variables are computed
3. Stand_ID: Sean Parks' stand identification
4. Plan_ID: Ramiro Rojas' stand identification
5. Project: project name
6. b_cwhr: CWHR size and density before any treatments
7. a_cwhr: CWHR size and density after any treatments
8. b_repro: reproduction CWHR habitat suitability for before any treatments
9. b_cover: cover CWHR habitat suitability before for any treatments
10. b_feeding: feeding CWHR habitat suitability before any treatments
11. a_repro: reproduction CWHR habitat suitability after any treatments
12. a_cover: cover CWHR habitat suitability after any treatments
13. a_feeding: cover CWHR habitat suitability after any treatments
14. Acres: Area of simulation unit

*** These CWHR habitat suitability values utilize the modified canopy cover values. See the "global parameters" section in Appendix C for details.

Description of the "CWHR_caspo" query

This query contains CWHR habitat information for the California spotted owl.

1. SU_ID: Identification for simulation unit. Use this field to join with GIS file "KRP_SU.shp".
2. Year: year variables are computed
3. Stand_ID: Sean Parks' stand identification
4. Plan_ID: Ramiro Rojas' stand identification
5. Project: project name
6. b_cwhr: CWHR size and density before any treatments
7. a_cwhr: CWHR size and density after any treatments
8. b_repro: reproduction CWHR habitat suitability for before any treatments
9. b_cover: cover CWHR habitat suitability before for any treatments
10. b_feeding: feeding CWHR habitat suitability before any treatments
11. a_repro: reproduction CWHR habitat suitability after any treatments
12. a_cover: cover CWHR habitat suitability after any treatments
13. a_feeding: cover CWHR habitat suitability after any treatments
14. Acres: Area of simulation unit

*** These CWHR habitat suitability values utilize the modified canopy cover values. See the "global parameters" section in Appendix C for details.

APPENDIX H – ACCURACY ASSESSMENT

To assess the accuracy of our projected vegetation would be impossible. Instead, we assess the accuracy of the initial vegetation conditions. To do this, we compare the plot-derived CWHR classes to the CWHR classes in the GIS vegetation layer.

This is not a traditional method for determining accuracy, which compares interpreted vegetation to real on-the-ground values obtained from plot data. Here, we compare our interpreted vegetation to what a GIS rendition (which is created with modeling, photo interpretation and site visits) says is on the ground. This GIS rendition of the landscape has its own associated errors and biases, so using it as a comparison of accuracy is not entirely appropriate. However, a comparison to the GIS vegetation layer does give us an indication of the accuracy.

To assess the accuracy, we take simulation units with plot data and compare the plot-derived CWHR classes to the GIS-based CWHR classes. The overall accuracy of the CWHR density class is 48.4%. This means that 48.4% of the simulation units (initial conditions – before any treatment) in the plot-derived CWHR density class match the CWHR density class of the GIS layer (table 7). The overall accuracy of the CWHR size class is 39.1%. This means that 39.1% of the simulation units (initial conditions – before any treatments) in the plot-derived size class match the CWHR size class of the GIS layer (table 8).

Table 7. Error matrix, producer's accuracy and user's accuracy for the CWHR density class. Horizontal axis is the reference class (GIS-derived values), while the vertical axis is the plot-derived classification.

Size	0	1	2	3	4	5	Total		Producer's accuracy		User's Accuracy	
0	34	0	1	16	9	0	60		0	26.0%	0	56.7%
1	0	0	0	0	0	0	0		1	0.0%	1	na
2	12	3	2	7	29	5	58		2	14.3%	2	3.4%
3	19	1	3	21	49	8	101		3	12.4%	3	20.8%
4	49	5	7	116	433	141	751		4	75.4%	4	57.7%
5	17	1	1	9	54	37	119		5	19.4%	5	31.1%
Total	131	10	14	169	574	191	1089		overall accuracy = 48.4%			

The error matrices in tables 7 and 8 show how the initial conditions were modeled by comparing plot-derived values in each simulation unit to those values in the GIS vegetation layer. The producer's accuracy represents how well a particular class is classified. Or in other words, of all the referenced sites that have a particular CWHR class, how many times (or what proportion) did those sites get classified as such? In table 7, for instance, there are 574 reference simulation units with CWHR size class of 4, and 433 of those simulation units are classified as a CWHR size class 4. The producer's accuracy for this class is 75.4% (754/993). The user's accuracy looks at the matrix from a different approach. Instead of looking at known reference data and calculating how many are correct (producer's accuracy), the user's accuracy looks at the number correctly classified and compares that to the number of sites in that classification. Again, in table 7, 751 simulation units were classified as CWHR size class 4, while 433 were classified correctly. The user's accuracy for this class is 57.7% (433/751).

These accuracy values, although seemingly low, are generally comparable to other fine-scale mapping projects. For example, Ohmann et al. (In Press), although their classification and accuracy assessment methods differed from ours, had producer's accuracy values ranging from 6-73% and user's accuracy values ranging from 8-83%, with an overall accuracy of 47%. Achieving perfect accuracy for multiple vegetation characteristics is impossible, as two plots are never exactly alike nor are the vegetation and explanatory factors perfectly correlated (Ohmann and Gregory 2002).

Table 8. Error matrix, producer's accuracy and user's accuracy for the CWHR size class. Horizontal axis is the reference class (GIS-derived values), while the vertical axis is the plot-derived classification.

Density	0	S	P	M	D	Total		Producer's accuracy			User's Accuracy	
0	35	2	6	7	10	60		0	24.1%		0	58.3%
S	23	11	18	15	7	74		S	26.8%		S	14.9%
P	42	7	52	33	45	179		P	26.0%		P	29.1%
M	25	16	68	139	193	441		M	53.7%		M	31.5%
D	20	5	56	65	189	335		D	42.6%		D	56.4%
Total	145	41	200	259	444	1089		overall accuracy = 39.1%				

Although the overall accuracy of the CWHR size and density classes appears low, we feel that there is much that can be learned and gained from this analysis. On a simulation unit basis, there is much error associated with the classification of the CWHR size and density classes to the individual simulation unit. The relatively low accuracy values indicate that the results are not appropriate for decisions or data interpretation at the scale of the simulation unit. However, we strongly feel, as one scales up to the stand, management unit or project area, the accuracy increases to an acceptable level. The results of this analysis should not guide planning and policy decisions at simulation unit scale, but should adequately inform decisions at the stand, management unit or project area scale.

To illustrate that the accuracy increases as one scales up to larger geographic units, we created tables comparing the acreage in each CWHR size and density class for the first eight management units (Tables 9 and 10). The difference between the acreage predicted (using plot data, MSN and the CWHR crosswalk) compared to that of the GIS vegetation layer in each CWHR size and density class is acceptable, as the values are relatively close in most cases.

Assessments using coarser attributes also illustrate that the accuracy is acceptable. We lumped CWHR size and density classes 4M, 4D, 5M and 5D together (henceforth called "habitat"), which are basically areas of larger trees and higher canopy cover. This habitat, according the CWHR models, are low, moderate and high suitability for fisher reproduction, moderate and high suitability for fisher cover, and moderate and high suitability for spotted owl cover. Table 11 shows a comparison between the plot-derived and GIS-derived habitat. For the first eight management units, the area of plot-derived habitat is 18% greater than the GIS derived habitat, and for the entire project area, the area of plot-derived habitat is 12% greater than that of the GIS-derived habitat.

To reiterate, our approach is not a traditional technique for assessing the accuracy. The traditional method compares the initial condition plot-derived CWHR values to real on-the-ground values. Instead, we are comparing the plot-derived CWHR values to CWHR values obtained from a GIS rendition of what is on the ground, which has its own associated errors. This assessment shows that, at broader scales than the simulation unit, our plot-derived habitat values are a reasonable representation of the current habitat conditions.

Table 9. Comparison of the plot-derived and GIS-derived acres in each CWHR size class.

		CWHR Size					
	Mgt. unit	0	1	2	3	4	5
Plot-derived acres	bear_fen_6	3	2	115	110	1,852	121
GIS-derived acres		38	78	42	297	1,295	453
Plot-derived acres	el_o_win_1	6	0	4	65	1,232	52
GIS-derived acres		157	0	0	65	975	162
Plot-derived acres	glen_mdw_1	65	0	84	45	1,185	240
GIS-derived acres		271	0	30	77	1,180	60
Plot-derived acres	krew_bul_1	51	0	31	81	829	160
GIS-derived acres		136	0	20	31	893	71
Plot-derived acres	krew_prv_1	21	0	15	84	1,717	62
GIS-derived acres		146	38	60	129	1,098	429
Plot-derived acres	n_soapro_2	412	0	127	608	1,099	175
GIS-derived acres		809	0	54	642	770	145
Plot-derived acres	providen_1	139		143	233	1,389	110
GIS-derived acres		284	33	20	470	769	438
Plot-derived acres	providen_4	22	0	82	66	791	86
GIS-derived acres		142	24	0	334	358	189
Plot-derived acres	First 8 MU	718	2	601	1,293	10,095	1,005
GIS-derived acres		1,984	173	227	2,045	7,338	1,947
Plot-derived acres	All 79 MU	3,220	2	3,877	7,733	46,305	10,757
GIS-derived acres		10,331	604	1,392	7,990	40,913	10,663

Table 10. Comparison of the plot-derived and GIS-derived acres in each CWHR density class.

		CWHR Density				
	Mgt. unit	-	S	P	M	D
Plot-derived acres	bear_fen_6	3	24	189	1,371	617
GIS-derived acres		123	57	319	323	1,383
Plot-derived acres	el_o_win_1	6	30	185	587	551
GIS-derived acres		157	38	132	518	514
Plot-derived acres	glen_mdw_1	65	174	209	1,096	75
GIS-derived acres		276	61	197	810	275
Plot-derived acres	krew_bul_1	51	126	448	477	50
GIS-derived acres		136	119	230	315	351
Plot-derived acres	krew_prv_1	21	28	193	1,073	585
GIS-derived acres		194	59	339	707	601
Plot-derived acres	n_soapro_2	412	311	447	282	969
GIS-derived acres		840	70	272	381	858
Plot-derived acres	providen_1	139	42	370	604	859
GIS-derived acres		317	19	379	363	936
Plot-derived acres	providen_4	22	18	82	379	546
GIS-derived acres		166	9	305	253	314
Plot-derived acres	First 8 MU	718	752	2,123	5,869	4,252
GIS-derived acres		2,209	432	2,172	3,669	5,233
Plot-derived acres	All 79 MU	3,220	5,129	11,078	34,063	18,404
GIS-derived acres		10,996	4,688	9,368	14,548	32,295

Table 11. Comparison of the plot-derived and GIS-derived acres of “habitat”.

Management unit	Plot-derived acres	GIS-derived acres	% over (under) GIS prediction
bear_fen_6	1,834	1,588	15
el_o_win_1	1,123	1,004	12
glen_mdw_1	1,144	1,066	7
krew_bul_1	513	647	(21)
krew_prv_1	1,587	1,299	22
n_soapro_2	832	692	20
providen_1	1,202	922	30
providen_4	816	455	79
First 8 MU	9,051	7,673	18
All 79 MU	47,464	42,244	12

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