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French Fire Recovery and Reforestation Project

Environmental Assessment

Bass Lake Ranger District, Sierra National Forest, Madera County, California

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1.0. Chapter 1. - Purpose of and Need for Action

1.1 Introduction

The Sierra National Forest (SNF) is proposing to take management action to respond to conditions created by the French Fire, which burned 13,832 acres of National Forest System (NFS) lands on the Bass Lake Ranger District (BLRD), during July and August 2014. An interdisciplinary team assessed the effects of the fire and worked with the Responsible Official, Forest Supervisor Dean Gould, to develop a proposal for post-fire treatment activities based on management objectives, science, and experience. The resulting proposal became the French Fire Recovery and Reforestation Project (Project). Proposed activities include salvaging roadside hazard trees, recovering the economic value of fire-killed/fire-damaged trees (hereafter termed, fire-affected), re-establishing forested conditions, managing fuels, and controlling invasive non-native plants. The SNF, United States Department of Agriculture Forest Service (USDA FS) has prepared this Environmental Assessment (EA) for the Project in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations.

The Project is subject to the standards and guidelines (S&Gs) and direction contained in the SNF Land and Resource Management Plan (SNF LRMP) (USDA FS 1992a) as amended by the Sierra Nevada Forest Plan Amendment (SNFPA) Record of Decision (ROD) (USDA FS 2004a, 2004b). The 2004 ROD provides for ecosystem restoration following catastrophic events. These restoration activities are included in all land allocations and call for managing disturbed areas for long-term fuels profiles, restoring habitat, and recovering the economic value of some dead and dying trees. Restoration projects can include salvage of dead and dying trees for economic value as well as for fuels reduction (USDA FS 2004b, page 6).

Under the SNFPA ROD errata (USDA FS 2004c), guidance of the SNFPA ROD (2004b, pages 52 and 53) clarifies salvage direction. This direction requires the design of salvage projects to: 1) reduce potential soil erosion and the loss of soil productivity caused by loss of vegetation and ground cover; 2) protect and maintain critical wildlife habitat; 3) manage development of fuel profiles over time; and 4) recover the value of timber killed or severely injured by the disturbance (USDA FS 2004b, page 52).

This EA discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives developed to meet the needs for treating the area. The EA also provides the supporting information for a determination to prepare either an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI).

Additional documentation, including more detailed analyses of resources in the Project area, may be found in the Project planning record located at the BLRD office in North Fork, California.

1.1.1. Background

The French Fire started on July 28, 2014 on the west drainage bottom of the San Joaquin River, within Lower Chiquito Creek, Rock Creek tributary watersheds. The fire moved across the rugged and heavily forested drainage of Rock Creek, crossing Forest Road 81 then up canyon to Mile High Vista and Mammoth Pool Reservoir. The fire spread west towards Shuteye Peak, then to the south threatening several small communities; before finally being contained on August 8,

2014. The cause of the fire was found to be an abandoned campfire. The fire burned approximately 13,832 acres of NFS lands and 3 acres of private land. No officially designated inventoried roadless or wilderness areas occur within the French Fire area.

Geographically located between Yosemite and Kings Canyon/ Sequoia National Parks, the Project area is almost entirely within the Lower Chiquito Creek, Rock Creek, Fish Creek, San Joaquin River, and Mammoth Pool Reservoir-San Joaquin watersheds (Figure 1). The legal description is Township 6 South, Range 24 East, Section 33; Township 7 South, Range 24 East, Sections 3-11, 14-22, 26-30, 32-35; Township 8 South, Range 24 East, Sections 2-5, 8-11, 15& 16, Mount Diablo Base Meridian.

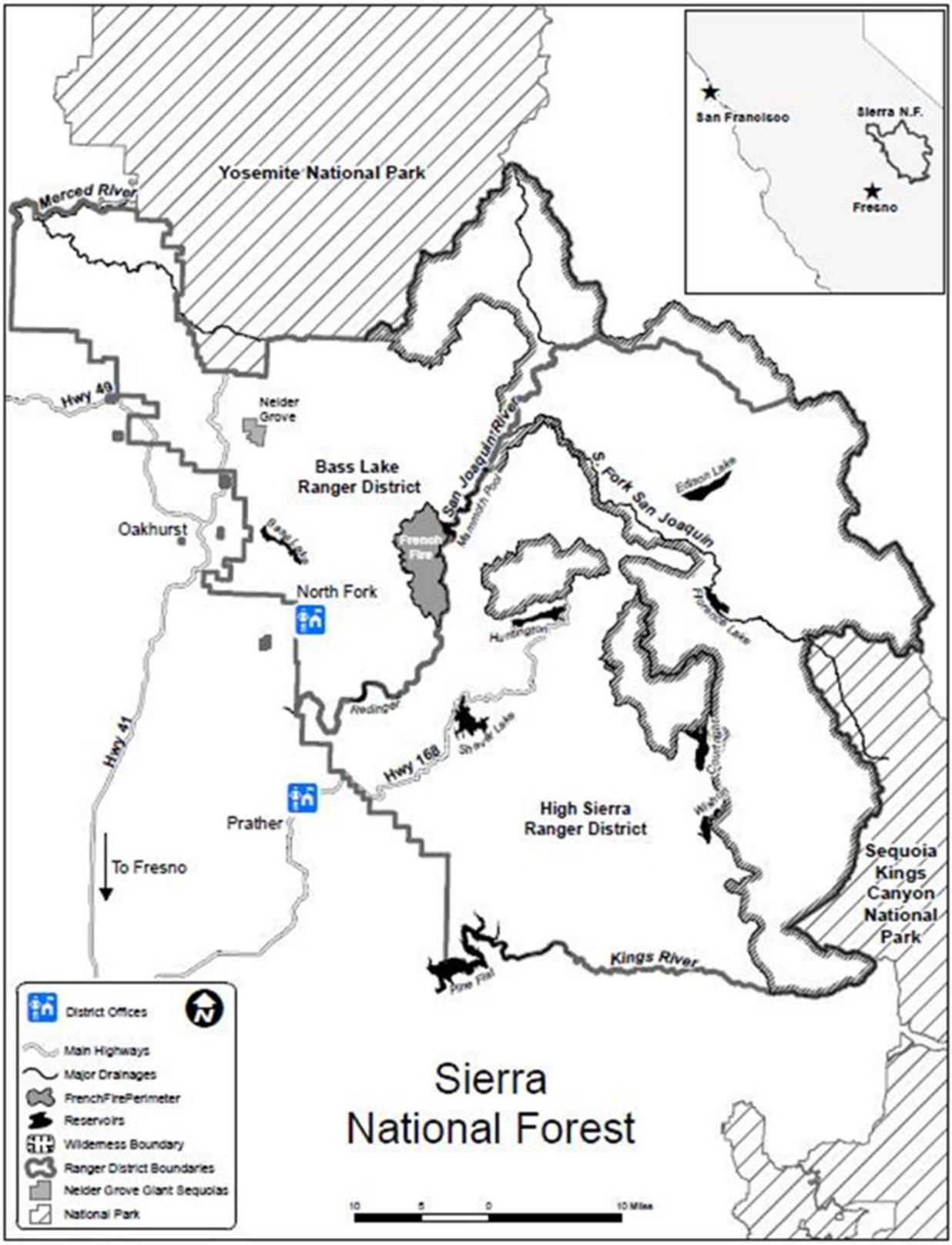


Figure 1. Vicinty map of French project

1.1.2. Existing Condition

Prior to the French Fire, vegetation within the Project was predominantly montane hardwood-conifer and moderate to dense Sierra mixed conifer forest. Dominant trees were ponderosa pine (*Pinus ponderosa*) and incense cedar (*Calocedrus decurrens*), with lesser amounts of white fir (*Abies concolor*), black oak *(Quercus kelloggii)*, and sugar pine (*Pinus lambertiana*). Shrubs either formed stands of montane chaparral or were more scattered in the understory: greenleaf manzanita *(Arctostaphylos patula)*, mountain whitethorn (*Ceanothus cordulatus*) and chinquapin (*Chrysolepis sempervirens*) are some of the more common species at mid-elevations. Throughout much of the conifer forest within the Project area, bear clover (*Chamaebatia foliolosa*) forms a solid ground-cover. Common shrubs at the lower elevations are canyon live oak *(Quercus chrysolepis),* Mariposa manzanita, deer brush *(Ceanothus integerrimus)*. The understory had varying amounts of conifer regeneration; and herbaceous (mostly native) plants were sparse to abundant on the forest floor – though in many areas the duff and needle layer was so thick that no herbaceous plants were present.

The fire burned at varying intensities as it moved across the landscape, resulting in a mosaic of vegetation burn severity effects (percent of basal area loss determined by Rapid Assessment of Vegetation Condition (RAVG) uses satellite imagery and describes post fire conditions on NFS lands) (Refer to **Error! Reference source not found.**). Within the fire perimeter, some areas xhibit very high vegetation burn severity effects where most, if not all, of the trees were killed by the fire. Other areas exhibit low to moderately low vegetation burn severity effects, where at least half of the stands (as measured by stand basal area) still include a green tree component. Of the approximately 13,832 acres of NFS lands that burned in the fire, approximately 53 percent (7,315 acres) of the fire area burned at high and moderate severity. Virtually all trees within the very high severity areas (5,466 acres) are dead or expected to die. A substantial portion of trees in the moderately high vegetation burn severity areas (approximately 1,800 acres of NFS lands) have been killed by the fire, and those that survived the fire are expected to experience high mortality as trees weakened by fire are more susceptible to insect attack.

There is a high probability of additional tree mortality due to fire injury and insect attack extending into areas exhibiting lower vegetation burn severity. The build-up of fuels due to lack of fire in the past increased the intensity of heat on the soil and roots of trees. This is projected to result in the loss of more trees over time. Tree mortality beyond those trees directly killed by the fire is expected to be exacerbated by the continued low levels of precipitation (both rain and snow) in the Sierra Nevada and specifically within the French Fire area.

Current drought conditions in California have not been this severe since the 1970's. The previous winter of 2013-2014, was recorded as the fourth driest year in the past four decades and the dry conditions are predicted to persist, according to the US Drought Monitor (January 27, 2015) and 2015-2016's winter showed no improvement. The existing condition of fire-injured trees in low and very low fire severity areas is expected to worsen because of the additional stresses of the ongoing "exceptional" drought and the presence of bark beetles.

In addition to the Lower Chiquito Creek, Rock Creek, and San Joaquin River, other major waterways impacted by the fire include Mammoth Pool Reservoir on the San Joaquin River, and within the burn perimeter, 15 miles of perennial streams, 21 miles of intermittent streams, and approximately 215 miles of ephemeral streams. These waterways are at risk due to a heavier sediment load (discussed in soils and hydrology reports) and degradation wildlife habitat without further restoration actions. Other resources potentially at risk from post-fire effects due to hazard

trees and the loss of soil coverage include Fish Creek Campground, Southern California Edison's hydropower facility on the San Joaquin River, Forest Road 81 (FR 4S81), the French Trail, and open adits, shafts, and hazardous materials at the Wisseman Mine.

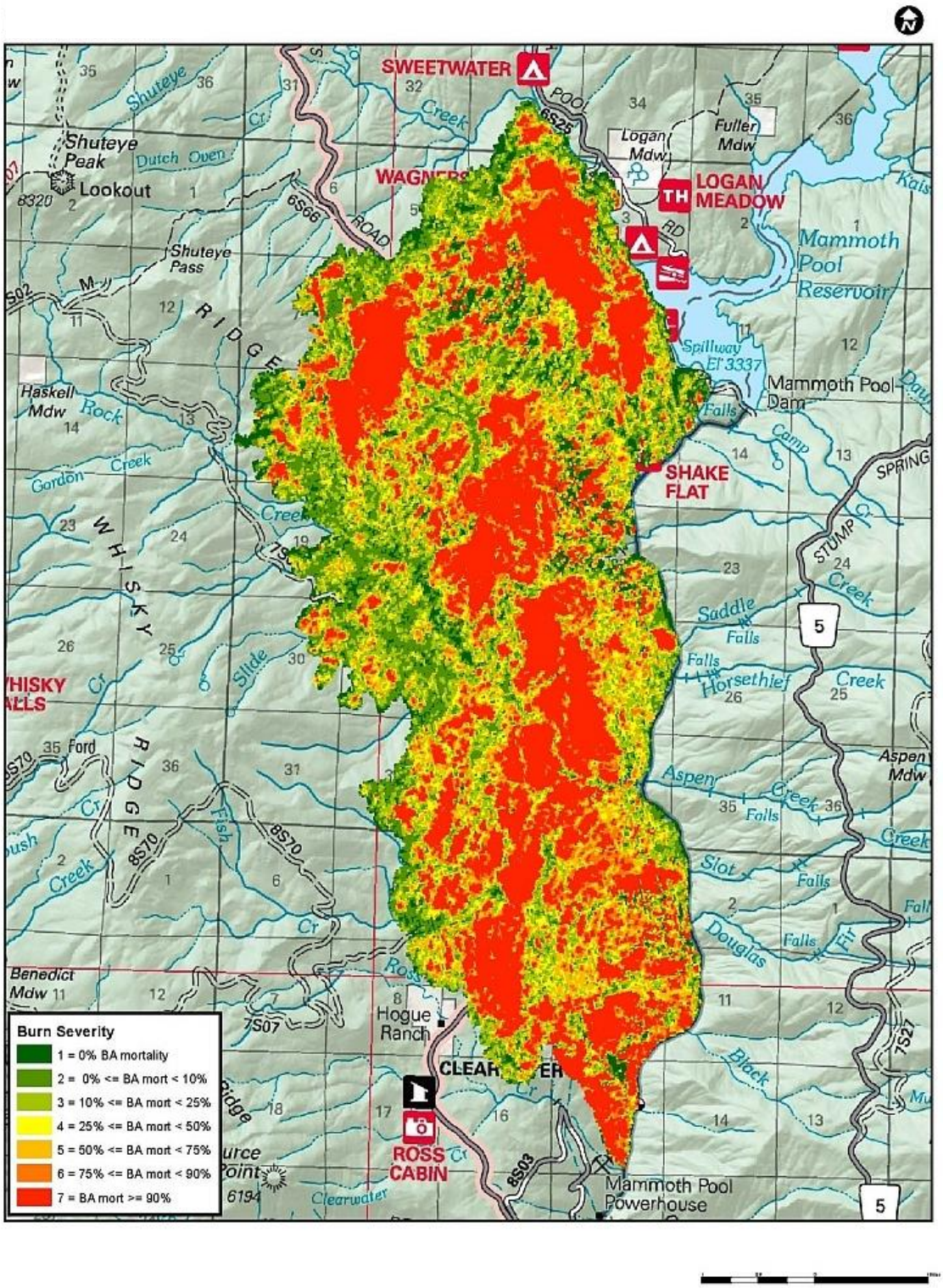


Figure 2 Burn Severity of the French Fire

Forest Plan land allocations, habitat, and landscape considerations within the Project include: General Forest, Old Forest Emphasis Area, dispersed and developed recreation areas, special use permit areas, California spotted owl *(Strix occidentalis occidentalis)* protected activity centers (PACs), Sierra Nevada yellow-legged frog (*Rana sierrae*), Yosemite toad (*Anaxyrus* [=*Bufo*] *canorus*), California red-legged frog (*Rana draytonii*) habitats, riparian conservation areas (RCA), deer holding areas, deer migration corridors and suitable Pacific fisher (*Pekania* [=*Martes*] *pennanti*) habitat. Each of these help shape the Project proposal.

The desired conditions for the Project area are guided by the SNF LRMP as amended and the Region 5 Ecological Restoration Leadership Intent publication and help to formulate the Purpose and Need. The SNF LRMP directs that management of land and resources be designed to maintain desired conditions or to move existing conditions toward desired conditions. Those desired conditions for responding to the effects of the French Fire include:

- Mitigate the threat to human health and safety as trees create a hazard along the FS transportation system or in areas of public and administrative use;
- Surface fuel load levels (10-30 tons per acre) managed to reduce the likelihood of high-intensity, large-scale fires within forest stands, while maintaining soil cover, coarse woody debris and snags for wildlife habitat;
- Recover economic value of forest products recovered in a manner beneficial to local communities and forest management;
- The Project area needs to furnish a landscape dominated by site-appropriate trees with variable densities and structure that provide watershed functionality, diverse wildlife habitat and forest products, and long term restoration of scenic/recreation value;
- The promotion of native vegetative communities free from invasive weeds and the natural recovery of native species.

Post-fire management treatments are generally focused in areas that experienced moderately high to very high vegetation burn severity effects (recognizing the mosaic pattern of vegetation burn severities). See Figure 2.

1.1.3. Need for Action

The high burn severity of the French Fire created safety concerns and a landscape with little heterogeneity within the Project area, in addition to other resource concerns. As a means of expediting the restoration of the land and mitigating the safety concern, this Project has been proposed as a management response to the French Fire. The desired conditions and the existing conditions in the Project area provide the basis for identifying the needs and then identifying the proposed actions to meet those needs. The needs for this Project are:

1.1.3.1. Provide for Safety

There is a need for the timely removal of fire-affected trees that pose a hazard in areas of high exposure to humans, particularly along the transportation system and recreation sites, to ensure the safety of the public, nearby communities, Forest Service personnel, and contractors. The French Fire created a large number of dead or structurally damaged trees across the landscape. The use of NFS roads and surrounding forest within the fire perimeter increases exposure and elevates the risk of injury to the public and forest workers as well as during fire suppression efforts from the collapse of dead or damaged trees. Action is needed to reduce the safety risk from falling dead or structurally damaged trees within the road prism and developed recreation sites.

1.1.3.2. Avoid Loss of Commodity Value of Fire-Affected Trees

The need to avoid the loss of commodity value sufficient to jeopardize the agency's ability to accomplish Project objectives, directly related to resource protection or restoration. The 2004 SNFPA ROD states: "Salvage harvest of dead and dying trees may be conducted to recover the economic value of this material and to support objectives for reducing hazardous fuels, improving forest health, re-introducing fire, and/or re-establishing forested conditions" (SNFPA ROD p. 52).

Within the first year following a fire, economic value decreases as trees begin to deteriorate due to wood-boring beetles introducing wood-decaying fungi. Accelerated wood decay of fire-affected trees necessitates prompt action to ensure harvested trees retain sufficient merchantable value to facilitate a timber sale and support restoration activities and fuel load reductions.

A viable timber industry and wood products infrastructure greatly improves the ability to treat and manage forest vegetation in a cost-effective and efficient manner, while providing long-term local employment. Conversely, the material provide by SNF supports that viable timber industry, and wood products infrastructure.

1.1.3.3. Manage Fuel Loading Levels

There is a need to manage fuel loading within the Project area to achieve short-term and long-term desired conditions. The rapid accumulation of fuels post-fire in the Project area poses an increase in fire hazard and potential for high severity fire throughout the area. Fire-affected trees would fall to the ground, creating hazardous surface fuel conditions. This downed material, especially in moderate and high fire severity areas, combined with newly established vegetation, would make a new fire in the Project area difficult to control. Due to the long dry summers in the Mediterranean climate of the area, the heavy fuels could remain on the ground for approximately 50 years or longer before decomposition (Peterson 2015), or fire removed them from the fuel load.

Additional fuel loading will continue to develop due to future projected tree mortality compounding existing fuel loading. A combination of successive drought years, high insect populations, ongoing insect attack in neighboring forest areas, and fire weakened trees have created a high probability for insect mortality within the Project area. Literature and observations on BLRD, within the North Fork, Cascadel and Aspen Fire areas, indicate that insect attack on fire-affected trees will contribute towards additional tree mortality. These fire-affected trees weakened by fire and killed by insects need to be removed to reduce the hazardous fuel loading. Managing fuel loading may only be feasible as a commodity value; the loss of that economic value has the potential to reduce the potential of removing the excess fuel from the Project area.

The potential of a future wildfire within the Project area necessitates appropriate actions to protect values that would be at risk during a fire. In addition to forest resources such as timber and wildlife habitat, high priority values for protection include Mammoth Pool, Arnold Meadow Subdivision, Minarets Work Center, Wagner's Resort, the Hogue Ranch, Clearwater Station, and developed recreation sites.

1.1.3.4. Provide Wildlife Habitat through Large Woody Debris and Snag Retention

There is a need to preserve habitat for a wide variety of native wildlife species in the Project area. The French Fire created large areas of snag-dominated habitat. The need for snag retention is

balanced with the need to reduce fuels hazards and future loss of live conifer, dense canopied habitats. Wildlife species that use snags would have an opportunity to use the snags retained areas within treatment areas. This aids in the creation of heterogenetic structure within the fire affected landscape. Snag retention areas provide habitat and are part of diverse habitat structures that favor a mix of wildlife species.

1.1.3.5. Reduce potential soil erosion and the loss of soil productivity caused by loss of vegetation and surface organic matter

There is a need to reduce potential soil erosion and the loss of soil productivity caused by loss of vegetation and surface organic matter from the French Fire. Within the high and moderate soil burn severities all or nearly all of the pre-fire soil cover and surface organic matter (litter, duff, and fine roots) has been consumed, leaving these areas highly susceptible to accelerated erosion and the loss of soil productivity. The remaining trees within the high burn severity and within some moderate soil burn severities, the canopy foliage has been completely consumed with few to no needles or leaves remaining to provide for protective soil cover. Increasing ground cover will provide the short term protection necessary to allow for soil stabilization and long-term forest productivity. Severely burned areas result in a reduction of ground surface cover that contributes to the support of plant growth, soil hydrologic function, and maintains watershed function.

1.1.3.6. Re-establish Forested Conditions

There is a need to re-establish forested conditions in areas of the Project that have been deforested (greater than 50% change in basal area) by the French Fire (RAVG data 9/25/14). Of the 13,835 acres of the French Fire, approximately 8,000 acres were dominated by conifers pre-fire. Approximately 4,000 acres of conifer dominated vegetation burned under moderate (50-75% change from pre-fire conditions--pockets or individual dead trees interspersed with live trees) to high (75-100% change from pre-fire conditions) fire severity (RAVG 2014). Approximately 1,200 additional acres burned with a change of 25-50% (RAVG 2014). Almost two thirds of the conifer dominated acreage within the French Fire has had a noteworthy change in vegetative cover. This has resulted in a reduction of multiple forest cover types that comprised a variety of wildlife habitats, and provided a range of forest products.

Most of the trees in the moderate to high severity burned areas that would provide a conifer seed source were killed. Without reforestation efforts conifer recovery would be very slow and much of the area could stay in the brush field/grassland stage for a century or more(McGinnis, et al. 2010). Over time the conifers growing through brush and bear clover cover, which would become prevalent following the fire, would consist of a high percentage of incense cedar and white fir; replacing the pine dominated stands of the pre-fire suppression era (McGinnis et al. 2010; North et al. 2009). Re-establishing native conifer cover quickly would minimize competition from bear clover, brush, and grass. Much of the low lying ground cover within the French Fire consisted of bear clover. Reforestation would provide the opportunity to include blister rust resistant sugar pine in the mixture of seedlings being planted. Bear clover and brush species that sprout from roots such as greenleaf manzanita and ceanothus species are particularly aggressive competitors for soil moisture delaying natural conifer reforestation.

Indicative of this competition and delayed reforestation is seen in portions of the areas that burned during the 1939 Source Point Fire and then re-burned during the French Fire. Due to their steep, inaccessible location no attempts were ever made to reforest these areas. These areas have remained in a brush dominated state ever since the Source Point Fire. Bear clover, oaks and

brush, particularly manzanita, ceanothus, black oak, canyon live oak, and grass are expected to recover naturally in these areas.

Due to the competition from bear clover, brush and grass for site resources that limit conifer regeneration, there is a need to control these conifer competitors. Bear clover, a rhizome rooted plant, quickly re-vegetates sites where it was present prior to the fire. Fire kills the tops of brush and shocks seed found in the soil. Brush species that regenerate from sprouts respond quickly to reinvade fire disturbed sites. Fire also stimulates dormant seed to sprout resulting in a flush of new brush seedlings. Areas with few or no conifer seed sources are dominated by brush (McGinnis, et al. 2010). Conifers released from the effects of brush competition result in successful reforestation efforts (McDonald and Fiddler 1989, McDonald and Fiddler 2010, McDonald et al. 2004). There is a need to control bear clover, brush and grass competition to allow the movement of the forest structure to a more mature stage.

The National Forest Management Act (NFMA) establishes congressional policy to maintain forests in an appropriate cover of trees in accordance with forest plans. The direction in the SNF LRMP, as amended, is to establish and maintain a multi-age, fire-resilient, native-species forest for multiple benefits and uses. Without treatment, re-establishment of forested conditions consistent with the SNF LRMP would be slow due to lack of a seed source and heavy competition from highly competitive vegetation such as bear clover. Therefore, there is a need to facilitate the establishment of appropriate forested conditions in portions of the Project area, creating heterogeneity, as the seed source is re-established and brush dominates area.

1.1.3.7. Manage Fuel Loadings within Defensive Fuel Profile Zones (DFPZ's) in Strategic Topographic Locations

There is a need to manage vegetation re-growth and fuel loading in identified DFPZ's to provide fire managers the needed anchor points and safe locations to engage future wildfires. DFPZ's have been identified in existing pre-attack planning maps and used during the suppression of the 2013 Aspen fire and the French Fire.

In these areas, fire-affected trees fall to the ground and while the shrub re-growth creates hazardous live and dead surface fuel conditions, inhibiting effective fire management in the future. Managed DFPZ's are also needed to help protect the established reforested areas in the event of another fire, while the planted trees are more vulnerable at a younger age.

1.1.3.8. Reduce existing fuel load and salvage trees felled along Southern California Edison Company Stevenson 12 kilovolt (kV) distribution line right of way.

There is a need to clean up the felled trees within the Southern California Edison Company Stevenson 12 kilovolt (kV) distribution line right of way, to reduce the fuel load. The trees were felled by the utility company during distribution line replacement operations from damage sustained during the French Fire. The current fuel loading due to the felled trees is well over 100 tons per acre (the desired fuel load is less than 20 tons per acre in the power line right of way) (Stalter professional opinion, winter 2014-2015). This will provide a large fuel bed capable of generating a very hot fire beneath and adjacent to the distribution lines. In the event of future wildfires in this area, this location would create a very hazardous situation for suppression forces due to the proximity to the power lines and large potential for arcing of electricity.

1.1.3.9. Eradicate Invasive Weeds to protect native vegetation and wildlife habitat

There is a need to address invasive weed infestations found within the Project area. The French Fire has created conditions suitable for the spread of invasive weeds, particularly medusahead *(Elymus caput-medusae),* which is present across about 32 acres in the southern part of the burn area and along roads outside the burn. Eradication of medusahead inside and immediately adjacent to the fire perimeter is necessary to prevent the spread of this highly invasive grass into vulnerable burned areas. Post-fire conditions, such as increased light, water, and nutrients, along with reduced competition for several years; can promote the growth and expansion of invasive weed species. Seeds of invasive non-native weeds may have been spread by vehicles, heavy equipment, wind, water, and animals; and may have been introduced into the burn area during fire suppression; suppression rehabilitation, or BAER treatments.

At this time, the Project area is not known to have weed infestations aside from medusahead and a few patches of bull thistle (*Cirsium vulgare*). The most likely additional invasive weed species to occur in the Project area are: woolly mullein (*Verbascum thapsus*), Italian thistle (*Carduus pycnocephalus*), klamathweed (*Hypericum perforatum*) tocolote (*Centaurea melitensis*), stinkwort (*Dittrichia graveolens*), and smilograss (*Stipa miliacea* ssp. *miliacea)*. This is based on the presence of these weeds on nearby lands and at the USFS compound in North Fork where fire suppression and road maintenance equipment had been staged prior to traveling to the French Fire area. Stinkwort and smilograss occur at the “boneyard” on the Forest Service compound at North Fork, where operations were staged toward the end of the fire.

1.2. Proposed Action

To respond to the purpose and need, the Responsible Official has proposed salvage harvest (totaling 3,371 acres), hazard tree removal (along approximately 60 miles of roads for approximately 2,353 acres, without overlapping treatments), DFPZ creation and maintenance (approximately 96 acres), SCE power line fuels treatment (approximately 112 acres without overlap), invasive weed treatment (approximately 32 acres), and tree planting (up to 3000 acres) in specified treatment areas. The total footprint of treatments on NFS lands under the proposed action would be approximately 5,965 acres. While no new permanent road construction is proposed, approximately 2.5 miles of temporary roads would be constructed and existing roads would be repaired and maintained. Chapter 2 provides a detailed description of the proposed action (Alternative 2). All proposed activities are consistent with the Forest Plan.

1.3. Emergency Situation Determination

In order to accelerate implementation of this Project to meet the purpose and need, the SNF is requesting an Emergency Situation Determination (ESD) pursuant to 36 Code of Federal Regulations (CFR) 218.21 (78 Federal Register 59, March 27, 2013; p. 18481-18504). The Chief and Associate Chief of the Forest Service may grant an ESD (36 CFR 218.21(a)). An emergency situation is a situation on NFS lands for which immediate implementation of a decision is necessary to achieve one or more of the following: relief from hazards threatening human health and safety; mitigation of threats to natural resources on NFS or adjacent lands; avoiding a loss of commodity value sufficient to jeopardize the agency's ability to accomplish Project objectives directly related to resource protection or restoration (36 CFR 218.21(b)). The determination that

an emergency situation exists is not subject to administrative review (36 CFR 218.21(c)). If an ESD is granted, the Project would not be subject to the pre-decisional objection process (36 CFR 218.21(d)). This proposed action has been designed to meet the S&Gs for land management activities described in the SNF LRMP as amended by the SNFPA FSEIS and ROD. In addition, compliance with all applicable laws, regulations, and policies will be incorporated into this Project.

1.4. Decision Framework

Given the purpose and need, the Responsible Official reviews the proposed action and the other alternatives to determine whether to implement the proposed action as described, select a different alternative, or take no action at all, and ensures the EA provide sufficient evidence and analysis for determining whether to prepare an EIS or a FONSI (FSH 1909.15, Chapter 41.1).

1.5. Public Involvement and Tribal Consultation

Initial public involvement efforts were used to develop the proposed action for the Project. These included meetings, telephone conference calls, and field trips with local tribal members, industry representatives, and environmental organizations from September into March 2015. The Forest hosted several multi-day field trips with tribal members and a field trip with a couple members of the Dinkey Landscape Restoration Project Collaborative. These field trips and discussions aided in Project development. The District Ranger discussed the Forest's intent to seek an ESD for post-fire salvage and restoration with community members during the public meeting (November 12, 2014), through tribal consultation and at the quarterly tribal forum (November 12, 2014), and with timber industry representatives in November 2014 and January 2015.

Formal public scoping for Project was initiated on October 30, 2014. Letters and emails were sent to approximately 550 interested and affected individuals and organizations and a legal notice published in *The Fresno Bee*, the SNF's newspaper of record. The following 11 groups/individuals responded to the Forest Service's scoping efforts: Chad Hanson and Justin Augustine for the John Muir Project and the Center for Biological Diversity; Larry Duysen for Sierra Forest Products; Kirby Molen also with Sierra Forest Products; County Board of Supervisors Tom Wheeler; Ben Solvesky and Sue Britting with Sierra Forest Legacy; California Department of Fish and Wildlife; United States Fish and Wildlife Service; and members of the public include Dick Artley; Joanne Freemire; Craig Schub; and Doug Waltner. Five of the respondents supported the Project proposal; while four were opposed to salvage logging and artificial regeneration, either preferring that the area remain as burned forest habitat and that natural regeneration processes occur throughout the French Fire area or suggested alternate actions for the area. Two of the respondents were Federal and State agencies offering recommendations. It is likely that objections would be filed by groups or individuals opposing activities proposed under the Project.

The Project has been posted on the SNF website since October 2014 and published in the quarterly Schedule of Proposed Actions (SOPA) since January 1, 2015.

1.5.1 Opportunity to Comment and Changes to Final EA

Appendix 6.9 contains the responses to public comments on the Project received during the opportunity to comment period (May 7, 2015 to June 8 2015). In response to the SNF's request

for comments, 8 interested parties submitted letters during the comment period. All letters, comments, and literature submitted were organized by commenter's name and displayed in a table by category area, commenter's comment and agency's response to the comment. (see Appendix 5.9).

No changes were made to the proposed action or other alternatives analyzed. The following edits have been made to this EA since the comment period. Edits have been made in response to comments from the public or clarifying information from the regional review team the week of July 13th. Document corrections and edits include;

- Editorial corrections: Typographical and formatting errors were corrected throughout the EA.
- Chapter 1: The first paragraph of 1.1.1. (Background) was edited to clarify land allocations.
- In section 1.1.36. (Re-establish forest conditions), language for pine stand era was edited to clarify scenario of climate change scenario.
- Chapter 2: Table 10 was edited to clarify the differences between alternative 2 and alternative 3 for Aquatics, Botany, Terrestrial Wildlife and Watershed/Hydrology. Information was also added to table 10 to clarify herbicide affects for Aquatic Wildlife, Botanic Resources and Watershed/Hydrology.
- In section 2.1.2.2. (Recover economic value of fire and insect-affected trees), a sentence was inserted to describe tree removal allowance on slope.
- In section 2.1.2.4. (Re-establish forest condition), slope identification was added as direction to proposed treatment types.
- Chapter 3: Table 9 (Comparison of alternatives by purpose and need), edits were made to Watershed (Hydrology) resource, alternative 3 to describe effects of ground disturbance.
- Aquatic Wildlife: The aquatic wildlife discussion clarified the effects and determination for the SNYLF, CRLF and other analyzed species. Design criteria 16-18 and 59 were edited to clarify condition of meadows as 'wet'. Design criterias 20 and 27 was edited to clarify direction for CRLF suitable 'breeding' habitat. Alternative 1 (section 3.2.3) clarification was identified regarding the project's affects for aquatic wildlife. In Alternative 3, section 3.2.5. (Cumulative effects) was edited to clarify the lack of herbicide would not change the Project's cumulative effects. Page 37 of the Aquatic BA/BE was edited to clarify identified meadow condition where no heavy equipment is proposed in these meadows, wetland or riparian areas.
- Forest Health/Vegetation: Design criteria #122 the sentence structure was edited to describe green pine logs and removed the term merchantable.
- Herbicide: In chapter 3, section 3.7.1. (Background and affected environment), the paragraph was restructured to clarify regional direction regarding Glyphosate. No content was changed.
- Economics: Minor corrections were made to table 16.

- Terrestrial Wildlife: The Fisher section, 3.9.19., was updated to provide more detail in determining effects. Herbicide affects was edited to clarify and address negligible effect of the herbicide.
- Watershed (Hydrology): The Hydrology report was updated to provide information on monitoring. The soils scope of analysis conclusion section was edited to clarify negligible effect of the herbicide. Information was added to the scope of analysis to clarify herbicide affects.
- Chapter 4: References: The reference section (4.2 References) was edited and updated to those overlooked during the draft EA.

1.6. Issues

The SNF separated 99 comments from the 11 response letters and one personal communication brought forward by the public into three categories:

1. Comments with issues to be addressed through the development of an alternative/s.
2. Comments with concerns or recommendations for the Project that could be resolved through the use of design criteria or addressed in the effects analysis.
3. Comments that have no issues, comments that are deemed to be outside the scope of the Project, or requests for information.

Issues (category 1) are points of disagreement, debate, or dispute about the potential for adverse effects based on undesirable effects related to the implementation of the proposed action and are used to formulate alternatives to the proposed action.

Concerns or Recommendations (category 2) include comments that are questions or misunderstandings of the proposed action (Project Scoping Comments and Issue Analysis located in the Project record) and would be addressed in the effects analysis, and/or additional Project design criteria were developed which reduce or eliminate the effects. This category also includes comments that are requesting a change/clarification in process (EA vs. EIS) or in the Project.

Non-Issues (category 3) are those deemed to be beyond the scope of the proposed action; irrelevant to the decision to be made; already decided by law, regulation, or policy; are requests for information to be included in the environmental documents or elsewhere; are conjectural in nature, not supported by scientific evidence; are analyzed under previous environmental documents; or have no apparent issue or are supportive of the Project or specific parts of the Project in general.

A list of non-issues and reasons regarding their categorization as non-substantive may be found in the Project Scoping Comments and Issue Analysis located in the Project record at the BLRD office in North Fork, CA.

After the 99 comments were separated and analyzed, concerns/recommendations raised by different commenters on the same subject and with the same intent and issue were grouped, and summarized into potential issues. The SNF identified 15 potential issues raised during the formal scoping period for consideration as category 1 or 2. The key issues have been addressed: through in the environmental effects analyses, and/or were used to develop alternatives. Those proposed as alternatives were considered and either fully analyzed or eliminated from detailed study. The

remaining comments were requests for information, provided research citations, were beyond the scope of the analysis, comments of support (category 3), or were used to develop design criteria. Four of the 15 potential issues were identified as category 2 comments and were used to develop design criteria.

Several of the 15 potential issues disputed the need to remove dead trees or reforest severely burned areas or any need for action in the Project area (category 3). Those comments reflecting the no action alternative, demonstrate the opinion of some public and researchers that post fire timber recovery efforts result in negative wildlife habitat effects. Additional comments fulfilled in the no action alternative and addressed in the silviculture report, include the opinion that trees with any green needles should not be harvested. As well as, comments discussing the amount of salvage harvests in black-backed woodpecker (BBWO) habitat. In particular, relative to the BBWO, salvage harvests remove needed habitat and therefore should not take place, is this addressed in the no action and the Management Indicator Species (MIS) report. In addition, the no action comments reflect the view that reforestation efforts are misguided and unnecessary to accomplish the objectives of maintaining forested habitats. This issue is addressed in alternative 1 (no action alternative).

Category 1 comments are discussed below.

1. **Protection of California Spotted Owl (CSO) foraging habitat.**
   A comment from the public informed the IDT to protect the CSO forging habitat and not treat plantations within 1.5 km around CSO core sites. The concern is related to the possibility that owls utilize burned areas for foraging around PACs. The combination of this comment and another resulted in the development of alternative 4, in which 282 acres of plantations were removed from treatment. The remaining plantations provide for the opportunity to meet the reforestation need of the Project. This issue is addressed under alternative 4, analyzed in chapter 3.

2. **Provide for natural range of variability and complex early seral forest (CESF) on the landscape.**
   A recommendation to avoid salvage logging in at least 15% of high severity areas and to retain a minimum of five patches of high burn severity areas at least 150 acres in size was brought to the IDT. The range of high burn severity patches in the alternatives is from 150 to 450 acres. The IDT determined that this recommendation was met in all alternatives.

   Another recommendation to provide for natural variability was to avoid logging in areas of high severity burned patches less than 10 acres in size and low to moderate burn severity areas. Utilizing this recommendation, alternative 5 removed two treatment units identified with this criterion and all secondary salvage. This issue is addressed under alternative 5 (no second entry), analyzed in chapter 3.

3. **Provide for forest resiliency when planting**
   A recommendation and concern that reforestation contain methods of providing opportunity for natural tree regeneration and a heterogeneous resilient forest. The IDT considered the feasibility of the recommendation and would already be utilizing best available science and follow policy and direction to create Project design. This issue is addressed under each alternative analyzed in chapter 3.

The herbicide application method recommended by the commenter was considered but eliminated from detail study (see Chapter 2, Alternatives Considered but Eliminated from Detailed Study).

4. **Herbicides pose risks to humans and wildlife.**
   The use of herbicides was a concern expressed by two individuals. The issue reflects the view of some members of the public that the use of herbicides is dangerous and risky to human health and wildlife, therefore should not be used.

   This issue is addressed under alternative 3 (no herbicide), which is analyzed in chapter 3.

5. **Harvest should consider wildlife habitat within high burn severity areas**.
   Commenter recommends not harvesting areas with the highest burn severity with largest trees/densities for reservation of BBWO, fisher and CSO habitat. The IDT concluded that the proposed action is partially accomplishing this recommendation by leaving 50% of the moderate to high burn severity. However, to fully analyze this issue, alternative 4 was developed with no salvage treatments outside of the roadside hazard and some plantations previously discussed in issue number 1. The alternative is designed to leave approximately 70% of the severely burned area untouched. The other 30% is within roadside hazard, previously discussed plantations, and/or other treatment that have not been made an issue. This issue is addressed in alternative 4 (Hazard trees and plantation salvage) analyzed in chapter 3.

   Another recommendation concerning wildlife habitat was to consider not treating within a 750 acre circular area surrounding CSO PACs in which less than 32% of the territory burned at high severity. Only one PAC within the Project area contains less than 32% of the area burned at high severity; for this reason three treatment units (totaling 37 acres) within the 750 acre circular area were removed in the development of alternative 5. The analysis of alternative 5, in chapter 3, will address this concern.

6. **Include cable and helicopter operations for harvesting.**
   This alternative was considered but eliminated from detailed study (see Chapter 2, Alternatives Considered but Eliminated from Detailed Study).

7. **Underground water storage tank**.
   A recommended alternative action considered but eliminated from detail study (see Chapter 2, Alternatives Considered but Eliminated from Detailed Study) was the development of one or more underground storage tanks with either gravity feed or a submersible pump and have the development as part of the Timber Sale Contract.

2.0. Chapter 2. - Proposed Action and Alternatives

This section describes and compares the alternatives considered for the Project. At the end of this section, the alternatives considered in detail are summarized in a table along with the associated environmental impacts for each so they can be readily compared (see comparison of alternatives section). The information used to compare the alternatives is based upon the design of the alternative and potential effects based on resource indicators.

Federal agencies are required to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the proposed action provided suggestions for alternative methods of achieving the purpose and need. Many recommendations were made, resulting in the formulation of three additional action alternatives; those three are analyzed in detail, in addition to the no action and proposed action.

All treatments proposed in this document are dependent on availability of the necessary funding. The alternatives considered but eliminated from detailed study are summarized at the end of this section.

2.1. Alternatives Considered in Detail

This section describes and compares the alternatives considered in detail for the Project. Alternative 1 (no action alternative) is an administrative requirement and helps the Line Officer make an informed decision. In addition to the proposed action (alternative 2), three additional action alternatives were developed as described in the previous Chapter.

2.1.1. Alternative 1 (No Action)

The analysis of the no action alternative provides reviewers a baseline to compare the magnitude of environmental effects of the action alternatives and the potential long-term impacts from not implementing the Project. Under the no action alternative, salvage harvest, hazard tree removal, DFPZ creation and maintenance, SCE power line fuels treatment, invasive weed treatment, prescribed burning, and tree planting in specified treatment areas would not occur.

Current management plans would continue to guide management of the Project area, for example recreation, grazing, Burned Area Emergency Response (BAER) treatments for invasive weeds and roads, and fire suppression would continue under existing decisions and authorities. In general, existing conditions in the Project area would be driven by vegetation response to fire effects, amount of precipitation, and insect attack. Fire-affected trees would be subject to decay and breakage. High and moderate severity areas most affected by the fire would see brush and oaks sprout and brush seed scarified by heat would germinate in the spring of 2015. Surviving conifers adjacent to high and moderate severity area would cast seed. Areas of low and very low severity still dominated by conifers would see increased growth. Additional invasive weed treatments would not be accomplished under this alternative.

2.1.2. Alternative 2 (Proposed Action)

Alternative 2 includes eight groups of activities that consist of: removing roadside and developed recreation site hazard trees, removing fire affected trees for economic recovery, snag retention, fuels reduction, road maintenance and construction of temporary roads and landings, reforestation treatments (site preparation, planting, and release (from competing vegetation), including the use of herbicides), and invasive weed eradication and control (including the use of herbicides). Proposed treatments within the fire perimeter are approximately 5,965 acres. Large and medium patches of existing burned forest habitat interspersed throughout the burned area would be left untreated under the proposed action. In addition, road accessibility and economic considerations associated with removing fire-killed trees in steep areas shaped the design of the Project.

Of the 13,832 total acres within the Project boundary, 7,926 acres were analyzed in detail for potential treatment; approximately 5,965 acres have some form of treatment proposed (Detailed Analysis Units). The remaining 7,867 acres have no treatments proposed due to fire severity, resource concerns, and slopes greater than 35%, standard and guideline limitations on treatment and/or no treatment is needed to meet the purpose and need. See Chemical treatment of invasive weeds, particularly medusahead, involves the potential of may be two treatments per year for up to 6 years, especially the first few years. The amount of ground treated would be less each year as the seed bank becomes depleted, since eradication is the goal for medusahead. Recent research (Kyser et al. 2012) shows that early spring applications of glyphosate at very low rates can provide excellent control of medusahead while sparing adjacent native perennial grasses. Thus in a given year there could be an early season application at low rates, along with a later season application at the more standard 2% solution when the plants are clearly visible.

The second application would be needed for plants that were not killed during the early season application (medusahead is difficult to identify earlier in the year) or in areas where the LOP for western pond turtles (WPT) is 325’ from streamsides until May 1. In these areas where medusahead is currently known to occur, no early season/low rate applications would be done between the 100’ SMZ buffer and the 325’ WPT buffer. The 225’ zone could only receive a late season, higher rate treatment.

Table 1, for approximate acres of treatments and Appendix A for a treatment area map for alternative 2.

To meet the purpose and need for the Project, the following activities are proposed:

2.1.2.1. Remove Roadside and Developed Recreation Site Hazard Trees

Hazard trees would be felled and removed along approximately 60 miles of roads within the Project area (totaling approximately 2,353 acres, if calculated with no overlap of treatments). Hazard trees will be assessed within 300 feet of the road or developed recreational areas; the majority of hazard trees marked to be removed would be within one tree height of these areas or approximately 150 feet.

Fire-affected and insect-affected trees along roads and near structures and developed recreation sites would be felled and removed. Determinations of hazard trees will be made using the Hazard Tree Guidelines for Forest Service Facilities and Roads in the Pacific Southwest Region (Angwin et al. 2012). In addition, hazard trees would be identified using the fire mortality guidelines from Marking Guidelines for Fire-Injured Trees in California (Smith and Cluck 2011), with an average probability of mortality = 0.7 used to determine which trees would be expected to die within 5

years. Hazard trees (which could be either fire-killed or live trees) would have to be within striking distance of a road, trail, or other improvements and show a high failure potential. High failure potential is determined by the presence of substantial defects such as, but not limited to, excessive lean, bole and root decay, bole cracks, severe burn injury to roots and/or bole, and dead tops.

The following activities are proposed for roadside and developed recreation site safety hazard treatments:

Mechanically remove fire-affected trees utilizing ground-based systems. Non-merchantable trees may be masticated (shredded), machine piled, removed as biomass or felled and left on site and potentially hand piled. Merchantable trees (generally greater than 10 inches diameter at breast height (dbh) depending on timing of removal) would be removed commercially harvested as sawlogs.

Treat slash concentration by hand or mechanically piling and burning, up to 300 feet within identified road corridors, to create and maintain a strategic control point for firefighter safety during fire suppression operations.

The treatment of fuels within the 300 foot roadside buffer would have fuels manipulation and/or reduction. This would be completed using varying methods dependent on the landscape, treatment, and fuel loading. Methods include lop and scatter to 18 inches from the ground, jackpot or pile burning, machine and hand piling, and biomass removal. The treatment would meet the requirements for both fuels reduction and soil protection.

Hazard trees within Fish Creek and Rock Creek Campgrounds would be cut and removed; slash would be piled and burned.

Borax fungicide treatment would be applied on all freshly cut conifer stumps 3 inches in diameter or larger (dead trees as well as trees with any green foliage) within developed recreation areas.

2.1.2.2. Recover Economic Value of Fire and Insect-Affected Trees

Removal of merchantable fire and insect-affected trees (sawlogs) utilizing mechanically ground-based logging systems is proposed to meet the need to recover commodity value for restoration and resource protection work from the Project area, totaling approximately 3,371 acres. Tree removal will occur on slopes less than 35%, short traverses up to 40% are allowed.

Fire-affected conifer trees would be felled and removed from high and moderate fire severity areas where conditions are suitable for ground based harvest. This first harvest would occur on approximately 2,000 acres, this treatment would occur immediately. Additionally other areas of high and moderate conifer mortality will occur as drought and insects take their toll on fire weakened trees, this is referred to as secondary entry. Secondary salvage areas are predominately in moderate burn severity, there is high burn severity and some low severity in fringe areas of the units. The timing on the secondary entry is dependent on the completion of the first entry into the road side hazard buffer and the first plantation and the rate at which additional mortality occurs from fire, drought, and insect mortality. This has the potential to occur as soon as spring or early summer of 2016.

The affected conifers in the secondary entry would be felled and removed from these additional areas that burned less severely, but have latent conifer mortality due to fire stress, prolonged

drought conditions and insect infestation. This secondary entry would total approximately 910 acres. Plantations within the fire area that would be treated include 477 acres, overlapping some of the first and secondary entries.

Tree removal operations within high and moderate fire severity areas would remove all trees in excess of snag retention needs using a probability of mortality rating. Areas of lower fire severity adjacent or within tree removal stands (high and moderate severity) are priorities for snag retention requirements.

2.1.2.3. Retain Snags

The Project's snag retention strategy requires the equivalent of 4 snags per acre be left throughout the Project area, maintaining heterogeneity in the landscape for wildlife. Snags on slopes exceeding 35 percent that do not pose a roadside hazard would be left to retain habitat for wildlife; snags would be left in large patches (1 to 200 acres+) and multi-snag clumps, particularly in key spotted owl and black-backed woodpecker habitat. Some snags would be randomly distributed throughout the stands to meet soil resource standards while in other areas, patches (several acres) or clumps of 4 to 10 snags would be left for wildlife resources. Snag retention patches or clumps are composed of dead (high and moderate severity) and live (low and very low severity) trees where possible. Snag retention needs would be evaluated and averaged for each 10 acres of trees removed. Where necessary, standing snags in areas that would be reforested could be felled, lopped and scattered to provide a safe working environment.

2.1.2.4. Re-establish Forested Conditions

Approximately 7,315 acres of NFS land experienced moderate to high vegetation burn severity, 3,320 acres of this mortality is in treatment areas. The area harvested for timber would be hand planted with 1 and 2-year-old mixed conifer seedlings (emphasizing shade intolerant pines where appropriate).

Reforestation includes site preparation and planting of native conifer seedlings in areas of moderate and high fire severity. Areas of naturally seeded conifers would be thinned and managed along with planted seedlings. All manually and mechanically piled vegetation would be burned, except where retained for wildlife cover. Site preparation and planting would take place on up to 3,000 acres. Replanting (the planting of seedlings in understocked areas where initial planting failed) would be undertaken in failed portions of plantations where necessary, if feasible.

Site preparation (jack pot and pile burning of slash concentrations) for planting would include mastication of dead trees and brush on slopes less than 50%, hand felling of dead trees, tractor piling of slash and brush on slopes less than 25%, grapple piling on slopes less than 45%, and chemical (Glyphosate and R11 surfactant) ground application. Site preparations related to chemical treatments (herbicide site prep treatment) are specifically proposed to control bear clover. Depending on slash concentrations, herbicide treatments can be expected to occur as soon as 2017 to allow for planting to begin in 2018.

Planting would be accomplished by hand. Power augers, hoedads, planting shovels or other hand planting tools would be used. Maintaining the trees as they grow and protecting them from competing shrubs, grasses, or bear clover would be accomplished by hand (hoes, axes, and chainsaws) (hand release treatment) or in some instances chemical (Glyphosate and R11 surfactant) ground application. Post-planting related chemical treatments (herbicide release treatments) are specifically proposed to control competing brush that sprouts from roots or stump

collar where hand treatments alone have proven ineffective. Successful establishment of pine plantations hinges on early control of competing vegetation before competing vegetation can capture scarce resources (McDonald and Fiddler 1989). Early dominance of conifers reduces the need for additional release or brush control measures. Bear clover rapidly recaptures the site following a fire. Bear clover probably presents the toughest competition for seedling survival and growth of any species in the Sierras. Due to the speed in which brush grows, timely harvesting of the trees would expedite the planting process resulting in one or more years of reduced competition and reduce the amount of competing brush reduce the need for additional release treatments. These species include deer brush, mountain whitethorn, greenleaf manzanita, and bear clover. The control of brush would primarily take place in planting areas.

For reforestation, herbicide application rates would typically be 2% solution of glyphosate, 1% solution of R-11, and 0.25 % solution of Colorfast Purple. This is referring to the mix that would be sprayed from the backpack sprayers, with water added. Glyphosate products typically used by the Forest Service have 51.8% (5.4 lbs) of active ingredient per gallon (prior to mixing with surfactant, dye, and water); or terms of acid equivalent (which the risk assessment worksheets use), 41% (4 lbs) of acid equivalent per gallon.

On average, 25 gallons of mix (or less) would be applied per acre. For site preparation (primarily bear clover) just one herbicide treatment is expected to be effective. In the occasional event that the treatment is not entirely successful (e.g. patches of bear clover were missed or were not completely killed); those areas would be treated in a following year (likely the next year). Some areas would also be treated in a following year to release planted conifer seedlings from competition. Please see the Vegetation section in Chapter 3.

2.1.2.5. Road Maintenance, Road Reconstruction, and Construction of Temporary Roads and Landings

In order to implement the Project and other management activities in the area, approximately 83 miles of existing NFTS roads would be repaired and maintained as necessary. Activities may include grading, improving drainage features, laying gravel, replacing culverts, etc. The Project design utilizes as many existing suitable temporary roads, skid trails, and landings as possible. Some existing temporary roads and landings would be reopened and approximately 2 miles of new temporary roads and landings would be constructed for Project implementation. Pre-haul maintenance would be completed to ensure that roads and drainage structures are functional. There would be no changes to the Motor Vehicle Use Map (MVUM).

Dust abatement would include a combination of water and dust abatement binder such as oil or magnesium chloride.

Approximately 2.5 miles of Maintenance Level 1 (closed roads) road segments would be upgraded to Maintenance Level 2 roads (high-clearance vehicles) for administrative use only. Approximately 2 miles of temporary roads would be constructed to implement the salvage logging operations, and then eliminated after Project activities are complete.

2.1.2.6. Create and Maintain DFPZ's in Strategic Locations to Help Manage Future Wildfires.

Fuels treatment and maintenance would occur on approximately 221 acres within existing and proposed DFPZ's, 126 acres overlap with other treatments. These areas are 150 feet wide and are located along dominant ridges and terrain features.

Fuels reduction treatments include the use of burning piles and underburning/jackpot, hand, mechanical (dozer or mastication) and chemical (glyphosate and surfactant R11) treatments. Chemical release treatments are specifically proposed to control woody plants that reestablish from seed and/or re-sprout from the base to keep these areas in a more open condition (reference application rates of Section 2.1.2.4. Re-Establish Forested Conditions). Treatments for DFPZs would occur one or two times over the course of a 5 or 6 year period and there would not be more than one treatment in any given year. The species include: buckbrush (*Ceanothus cuneatus*), deer brush, mountain whitethorn, Mariposa manzanita (*Arctostaphylos viscida* ssp. *mariposa*), green leaf manzanita, and bear clover.

2.1.2.7. Cleanup of felled trees along Southern California Edison Company (SCE) Stevenson 12 kilovolt (kV) distribution line right of way.

Fuels treatments within the SCE Stevenson 12 kV distribution line right of way would occur on approximately 290 acres within a 300 foot wide (150 feet on either side of centerline) corridor. The primary fuels reduction treatment~~s~~ would be accomplished by mechanically removing currently downed trees utilizing ground-based logging systems. Other methods to reduce fuels would be piling-by machine or hand, burning piles and underburning with jackpots of fuels.

2.1.2.8. Invasive Weed Eradication

Medusahead would be controlled using a combination of manual, mechanical, and chemical methods, each timed for maximum efficacy (integrated pest management). Herbicide treatments for invasive weeds would be done with backpack sprayers by workers walking the ground. Medusahead plants and patches would be sprayed with glyphosate with R-11 surfactant (initially aminopyralid herbicide and Agri-dex surfactant were also considered, but these have been dropped from the Proposed Action). Native and desirable non-native plants would be avoided to the extent practical. Medusahead in SMZs would be controlled with manual methods only, see Project Design Criteria for herbicides in section 2.1.6.3. Invasive weed treatments have been carefully designed to eliminate weeds while protecting native plants, wildlife, and water quality; as well as human health and safety.

Treatments would occur each year until monitoring determines infestations have been eradicated. Medusahead seed is not generally viable for more than 2-3 years thus by 5-6 years eradication is possible.

Other invasive weed species (discussed Section 1.1.3.9) encountered during surveys would be treated using a combination of hand pulling and glyphosate applications with surfactant R-11.

Herbicide and mechanical treatments for invasive weeds would only occur within the following areas:

- Polygons of known medusahead infestations,
- Roadside hazard zone (300’ on either side of roads shown on map),
- SCE powerline corridor,
- Detailed Analysis Units where salvage logging and reforestation are proposed,
- Defensible Fuel Profile Zones (DFPZs).

Invasive weeds occurring outside these locations would be manually controlled only.

Chemical treatment of invasive weeds, particularly medusahead, involves the potential of may be two treatments per year for up to 6 years, especially the first few years. The amount of ground

treated would be less each year as the seed bank becomes depleted, since eradication is the goal for medusahead. Recent research (Kyser et al. 2012) shows that early spring applications of glyphosate at very low rates can provide excellent control of medusahead while sparing adjacent native perennial grasses. Thus in a given year there could be an early season application at low rates, along with a later season application at the more standard 2% solution when the plants are clearly visible.

The second application would be needed for plants that were not killed during the early season application (medusahead is difficult to identify earlier in the year) or in areas where the LOP for western pond turtles (WPT) is 325' from streamsides until May 1. In these areas where medusahead is currently known to occur, no early season/low rate applications would be done between the 100' SMZ buffer and the 325' WPT buffer. The 225' zone could only receive a late season, higher rate treatment.

Table 1. Summary of Alternative 2 treatment activities

Activities	Acres Treated
Total Salvage Harvest[1] • First entry acres • Secondary entry acres • Plantations	**3,371** 1984 910 477
Total Roadside Hazard Tree Removal (with overlap) • Without overlap	**3712** 2353
Total Reforestation – Site Preparation and Tree Planting[2] • Estimated Replanting after initial planting • Estimated herbicide site prep treatment • Estimated herbicide release treatment • Estimated hand release treatment (*funding dependent*)	**Up to 3,000** 500 2,600 450 1,600
DFPZ creation and maintenance *(no overlap, hand mechanical)*	96
SCE Power Line Fuels treatment *(no overlap, hand mechanical)*	112
Estimated Invasive Weed treatment *(chemical and other methods)*	32
Transportation (miles) • Road maintenance/reconstruction • Temporary road construction	 83 2.5
Total Footprint of Treatment Areas[3]	**5965**

2.1.3. Alternative 3 (No Herbicide)

Alternative 3 was developed in response to issues brought forward during public scoping and input from Region 5.

Alternative 3 differs from Alternative 2 in that no herbicides would be applied for any purpose. Management techniques for achieving the purpose and need would be limited to manual or mechanical methods for reforestation, DFPZs, and invasive weeds. All other treatments would remain the same as alternative 2. See **Table 2** for treatment acres and Appendix A for detailed analysis unit map of alternative 3.

[1] Roadside hazard tree removal overlaps 1,359 acres of the identified salvage harvest and planting areas.
[2] The tree planting involves hand or mechanical site preparation and chemical release.
[3] The total "footprint" acreage figure does not include overlap with other treatment areas. It represents the actual landscape footprint.

2.1.3.1. Re-establish Forested Conditions

Reforestation strategies would occur as described in the proposed action; however no herbicides would be used to control bear clover, and competing brush that sprouts from roots or stump collar, including deer brush, whitethorn, and green leaf manzanita, during reforestation efforts. Instead competing vegetation would be hand grubbed (hoed) for a radius of 4 to 5 feet around planted trees within a few days of planting. At least two additional hand grubbing treatments would be required; one every two to three years, as bear clover reinvades the planting spot. Replanting would be done in failed planting areas. At least one total replanting treatment is anticipated due to projected poor survival. Bear clover would remain outside of the grubbed planting areas. Bear clover rhizome root systems would continue to compete for moisture within the grubbed areas.

All hand and mechanically piled vegetation would be burned, except where retained for wildlife cover. Maintaining the trees as they grow and protecting them from competing shrubs, grasses, or bear clover would be accomplished by hand (hoes, axes, and chainsaws). See **Table 2** for a comparison of the differences in site preparation and release treatments.

2.1.3.2. Invasive Weed Eradication

Invasive weed control under alternative 3 would use mechanical and/or manual methods. Medusahead would be controlled without the use of herbicides. Methods would be hand-pulling and bagging, hoeing, and string trimming; over a gross area of approximately 32 acres. The known locations of medusahead are identified in Appendix A. It is also expected that new occurrences of this species and possibly other weed species would be discovered within other areas of the Project area. Multiple entries would occur each year to ensure that control methods are adequate, unless the success of manual and mechanical methods is too poor to continue in areas of dense infestation.

Other weed species, as described in alternative 2, would be treated with similar techniques described above if found within the Project area Treatments would occur each year until monitoring determines infestations have been eradicated.

Table 2. Summary of Alternative 3 treatment activities

Activities	Acres Treated
Total Salvage Harvest[4] • First entry acres • Secondary entry acres • Plantations	**3,371** 1984 910 477
Total Roadside Hazard Tree Removal (with overlap) • Without overlap	**3712** 2353
Total Reforestation – Site Preparation and Tree Planting[5] • Estimated replanting (*several replanting efforts*) • Estimated hand release (*3 treatments minimum*) • Estimated herbicide site pep treatment	**Up to 3,000** 5,000 9,000 0
DFPZ creation and maintenance *(no overlap, hand mechanical, chemical)*	96
SCE Power Line Fuels treatment *(no overlap, hand mechanical)*	112
Estimated Invasive Weed treatment	

[4] Roadside hazard tree removal overlaps 1,359 acres of the identified salvage harvest and planting areas.
[5] The tree planting involves hand or mechanical site preparation.

• Chemical • Mechanical, hand	0 32
Transportation (miles) • Road maintenance/reconstruction • Temporary road construction	83
Total Footprint of Treatment Areas[6]	**5965**

2.1.4. Alternative 4 (Hazard Tree and Plantation Salvage Only)

This alternative was driven by external scoping.

Alternative 4 reflects the public's concern for salvage logging in moderate to high burn severities and treatments in proximity to California Spotted Owl Protected Activity Centers (CSO PACs). This alternative differs in salvage treatments from Alternative 2 because it would only remove roadside and developed recreation site hazard trees and harvest salvage trees within plantation units only that are greater than 1.5 kilometers (circular area) from California Spotted Owl PACs.

The other proposed treatments for snag retention, roads, DFPZ, SCE's power line right-of-way, and invasive weeds would be the same as alternative 2; although, the acres of overlapping treatments differ, as shown in **Table 3**.

2.1.4.1. Remove Roadside and Developed Recreation Site Hazard Trees

Under alternative 4, the same amount of miles of roadside hazard trees would be treated; however, since there would be fewer acres of salvage and secondary salvage being treated, there would be less of an overlap of hazard trees treatment areas. The hazard trees that would have been removed in the salvage treatment areas identified in alternative 2 would now be considered under the roadside hazard tree removal treatments, totaling 3,513 acres of no overlapping treatments. Methods of hazard tree removal would be the same as alternative 2.

2.1.4.2. Recover Economic Value of Fire and Insect-Affected Trees

Alternative 4 differs the most from the other action alternatives in the location of salvage treatments, as there would be no first or second entry salvage, except in plantations over 1.5 km from CSO PACs. Fire affected trees would not be removed in approximately 70% of high severity burn areas outside of these identified plantation units and the roadside hazard tree buffer. Approximately 518 acres would be treated within plantation units.

Thirty plantation units or portions of units (approximately 300 acres) would not be treated since these units overlap the 1.5 km circular area surrounding owl territory centers.

[6] The total "footprint" acreage figure does not include overlap with other treatment areas. It represents the actual landscape footprint.

2.1.4.3. Re-establish Forested Conditions

Site preparation and planting would still occur as specified in alternative 2. However, the location of the planting would be restricted to areas of high burn severity in the roadside hazard tree treatment and the plantation units that do receive salvage treatment.

The same thirty plantation units that would not be salvage logged would not be planted because of areas that overlap the 1.5 km circular area surrounding owl territory centers.

Table 3. Summary of Alternative 4 treatment activities

Activities	Acres Treated
Total Salvage Harvest[7] • First entry acres • Secondary entry acres • Plantations	**514** 0 0 514
Total Roadside Hazard Tree Removal (with overlap) • Without overlap	**3712** 3513
Total Reforestation – Site Preparation and Tree Planting[8] • Estimated replanting • Estimated herbicide site prep treatment • Estimated herbicide release treatment • Estimated hand release treatment (funding dependent)	**Estimated 2,400** 400 2000 300 1300
DFPZ creation and maintenance *(no overlap, hand mechanical, chemical)*	138
SCE Power Line Fuels treatment *(no overlap, hand mechanical)*	136
Estimated Invasive Weed treatment *(chemical and other methods)*	32
Transportation *(miles)* • Road maintenance/reconstruction • Temporary road construction	 83 2.5
Total Footprint of Treatment Areas[9]	**4333**

2.1.5. Alternative 5 (No Secondary Entry)

Alternative 5 was developed from external scoping comments.

The difference between alternative 5 and alternative 2 is that fire affected trees would be removed and harvested on approximately 1,946 acres in moderate to high burn severity as the only salvage entry. 910 acres of predominately moderate burn severity would not be treated. First entry units, u33m (4 acres) and u53m (4 acres) would not be treated so that patches of 10 acres or less would not be treated in high severity areas. Units u47m (5 acres), u453m (23 acres) and portions of u52m (9 acres) would not be treated because they fall within 1 km circular area of CSO PAC MAD45 in which less than 32% of the territory burned at high severity.

The other proposed treatments for snag retention, roads, DFPZ, SCE's power line right-of-way, and invasive weeds would be the same as alternative 2; although, the acres of overlapping treatments differ, as shown in **Table 4**.

[7] Roadside hazard tree removal overlaps 199 acres of the identified salvage harvest and planting areas.
[8] The tree planting involves site preparation and chemical release.
[9] The total "footprint" acreage figure does not include overlap with other treatment areas. It represents the actual landscape footprint.

2.1.5.1. Remove Roadside and Developed Recreation Site Hazard Trees

Under alternative 5, the same amount of miles of roadside hazards would be treated; however, since there would be no secondary entry for salvage treatment, there would be less of an overlap of hazard trees treatment areas. The hazard trees that would have been removed in the second entry treatment areas identified in alternative 2 would now be considered under the roadside hazard tree removal treatments, totaling 2,773 acres of no overlapping treatments. Methods of hazard tree removal would be the same as alternative 2.

2.1.4.2. Recover Economic Value of Fire and Insect-Affected Trees

Alternative 5 differs in that the secondary entry of salvage treatments would not take place, in response to the scoping comment concerned with treating in low to moderate burn severity areas. Fire affected trees would not be removed in approximately 56% of high severity burned areas outside of the identified first entry units areas and the roadside hazard tree buffer. Approximately 2,461 acres would be treated in this alternative.

2.1.4.3. Re-establish Forested Conditions

Site preparation and planting would still occur as specified in alternative 2. The location of the planting would be restricted to areas of high burn severity in the roadside hazard tree treatment and salvage treatment areas.

Table 4. Summary of Alternative 5 treatment activities

Activities	Acres Treated
Total Salvage Harvest[10] • First entry acres • Secondary entry acres • Plantations	**2461** 1946 0 518
Total Roadside Hazard Tree Removal *(with overlap)* • Without overlap	**3712** 2773
Total Reforestation – Site Preparation and Tree Planting[11] • Estimated replanting • Estimated site prep herbicide treatment • Estimated herbicide release treatment • Estimated hand release (*funding dependent*)	**2,900** 450 2500 400 1600
DFPZ creation and maintenance *(no overlap, hand, mechanical, chemical)*	105
SCE Power Line Fuels treatment *(no overlap, hand, mechanical)*	114
Estimated Invasive Weed treatment *(chemical, and other methods)*	32
Transportation (miles) • Road maintenance/reconstruction • Temporary road construction	 83 2.5
Total Footprint of Treatment Areas[12]	**5453**

[10] Roadside hazard tree removal overlaps 939 acres of the identified salvage harvest and planting areas.
[11] The tree planting involves site preparation and chemical release.
[12] The total "footprint" acreage figure does not include overlap with other treatment areas. It represents the actual landscape footprint.

2.1.6. Design Criteria Common to All Action Alternatives (except when specified)

Design criteria for the Project were developed to minimize potential environmental impacts to resources. Design measures will include but are not limited to measures from the applicable SNF LRMP S&Gs, Forest Service Manuals and Handbooks, and Best Management Practices (BMPs). The following design criteria are applicable to all alternatives unless specified (i.e. Aquatics # 25 and 26).

2.1.6.1 Air Quality

The SNF LRMP states that "Forest activities would be managed so air quality is compatible with federal, state and local laws; including a program that achieves the CAA responsibilities" (USDA FS 1992a, pg. 4- 2). The SNF LRMP has S&Gs for air quality (USDA FS 1992a, pgs. 4-25) that includes the following:

1. Cumulative impacts to air quality would be avoided by coordinating prescribed burning activities within the Forest, with burning activities conducted by others (LRMP S&G #216).
2. Fugitive dust impacts on air quality would be mitigated by including dust abatement as a requirement for construction activities that have potential to generate dust (LRMP S&G #217).
3. Prolonged effects from prescribed burning activities on air quality would be avoided by burning only on Air Quality Control Board (AQCB) approved burn days when satisfactory wind dispersion conditions prevail (LRMP S&G #218).
4. Participation with AQCB would occur to qualitatively define air quality control regulations and guidelines and effects of air quality on the Forest, from sources outside the Forest (LRMP S&G#219).
5. Appropriate permits would be obtained prior to conducting prescribed burning activities (LRMP S&G #220).
6. Air quality management considerations would be incorporated into fire management (LRMP S&G #230).

2.1.6.2. Aquatic and Riparian Species and Habitat

The purpose of these design criteria is to avoid or minimize the potential for adverse effects to the species and habitats that will be analyzed in the aquatic Biological Evaluation / Biological Assessment, and to be consistent with the Programmatic Biological Opinion. Management activities within Riparian Conservation Areas (RCAs) or Critical Aquatic Refuges (CARs) will be designed to (1) minimize risk of sediment entry into aquatic systems and (2) minimize impacts to habitat for aquatic- and riparian-dependent species. These design criteria will apply to any additional Alternatives developed. Additional design criteria may result during Project development (e.g. stand by stand consultation with USFWS).

Aquatic and Riparian Species and Habitat

General

7. Any wet meadows, streams, seeps, springs, fens, and/or wet areas discovered during Project implementation that are not already identified on Project analysis maps would be treated as perennial areas with 300 foot RCA and 100 foot SMZ buffers, on a case-by-case basis in consultation with appropriate specialists (ROD RCA designation of special aquatic features, pg. 42).
8. Report any discovery of amphibians or reptiles (e.g. frogs, toads, salamanders, and turtles) during Project sale preparation and implementation to the District aquatic biologist immediately. (ROD 2004 Goal; Species Viability, Plant and Animal Community Diversity).
9. If newly listed or unknown occurrences of federally listed threatened, endangered, proposed, candidate or Forest Service sensitive aquatic species are found within the affected Project area during sale preparation and implementation, additional species protection measures may be needed. (ESA LRMP and ROD compliance).
10. Riparian vegetation would not be cut during Project activities unless coordinated with the District aquatic biologist. (LRMP S&G 37, 69; ROD 2004 S&G 92, 96, 101, 103, 105, 111).

Fuel Storage / Refueling

11. Fuels and other toxic materials would not be stored in RCAs unless the location is agreed to in advance by the District aquatic biologist. (S&G #99, BMP 2.11)
12. Refueling of chainsaws or other equipment within RCAs (LRMP S&G 69, 75, ROD S&G 92, 99, ROD desired conditions, species viability (minimizing impacts)):
    a) Do not refuel heavy equipment within an RCA unless there are no other alternatives. Refueling of all equipment is to occur outside SMZ's (BMP 2-12) and at least 100 feet from any riparian area.
    b) Any spills (regardless of amount) must be cleaned up immediately. As much as possible, refuel chainsaws over spill pads to avoid soil and water contamination. To aid in refueling efficiency, spill pad can be attached to and carried on the refueling container.
    c) Site specific refueling area plans for difficult terrain within the Project area can be developed for refueling within an RCA if no other options are available (i.e.: use of spill pad under chainsaw while refueling within RCA).
    d) If site specific refueling area plans are developed, at a minimum, refueling must take place outside of the SMZ (BMP 2.11).
    e) Ensure that spill plans are reviewed and up-to-date. (ROD S&G 99, BMP 7.4)
    f) Storage of heavy machinery would occur only at approved areas such as existing landings, existing roads, or turnout areas, and should be outside of RCA and RMAs (refer to BMP 2.11 for additional measures).

Piles and Burning

13. Hand piling of slash / brush would be located at a minimum distance of:

Table 5. Distance for stream classes

Stream Class	Distance (*ft*)
I	50
II	25
III, IV, V	10

14. Slash / brush piles would be ignited using a pattern that allows animals to escape the fire. For example, light the pile at one end or leave an area unignited that serves as an escape route (specialist professional opinion).
15. Piles would be burned in fall or winter. Piling burning in the spring is to be avoided, but hand piling and burning may be allowed in the spring on a case-by-case basis in consultation with the hydrologist or aquatic biologist (specialist professional opinion).

For protection to aquatic/riparian species, meadows, and streams habitats within RCA / SMZs (LRMP S&G 37, 69, 75, 77, 78, 79; ROD S&G 92, 94, 96, 100, 102, 105, 108, 118):

Meadows

16. No new skid trails within 100 feet of any wet meadow unless the location is agreed upon by the District hydrologist or aquatic biologist prior to implementation.
17. Trees within 50 feet of all wet meadows: Drop and leave trees unless they can be felled directly onto a road; trees are to be dropped by hand. Evaluate, on a case-by-case basis with appropriate specialist, if all trees within the vicinity would need to be dropped.
18. Removal of incidental trees within 50 feet of wet meadows can only occur if no soil disturbance would result.
19. No mechanical dragging of materials or trees through meadows.

Streams

For removal of trees within SMZs:

20. For the protection of California red-legged frog habitat, no mechanical treatments would occur within 100 feet of identified California red-legged frog suitable breeding habitat (specialist professional opinion).
21. Above 5,000 feet elevation, for the protection of Sierra Nevada yellow-legged frog habitat, Class I and II stream SMZs would extend 100 feet on either side of the channel, and no disturbance would be allowed (District Ranger decision, November 17, 2014).
22. Below 5,000 feet elevation, for the protection of western pond turtle and foothill yellow-legged frog, no mechanical activities would be allowed within 325 feet on either side of perennial streams from October 1 through June 15 (District Ranger decision, November 17, 2014).

Below 5,000 feet elevation, **Table 6** would be followed.

Table 6. SMZ buffers for streams below 5,000-feet elevation

Stream Type (*Order*)	**Stream Class**	**SMZ Width** (*feet*) 30% Slope	**SMZ Width** (*feet*) 40% Slope	**SMZ Width** (*feet*) 50% Slope	**SMZ Width** (*feet*) 60% Slope	**SMZ Width** (*feet*) 70% Slope
Perennial (≥4)	I	100	130	160	190	220
Perennial/Intermittent (3)	II	75	105	135	165	195
Intermittent (2)	III	50	80	110	140	170

Ephemeral (1)*	IV-V	0-25	0-45	0-65	0-85	0-105

*Class IV-V SMZ buffer to be determined by the Timber Sale Administrator with consultation of the District Hydrologist or Fisheries Biologist if necessary.

23. Within SMZs, trees that are to be felled and left should be felled in the direction of natural fall (if practical and possible). Leave these trees as they fall (specialist professional opinion).
24. No dragging or end-lining across stream channels. (LRMP S&G 37, 69, 75, 77, 78.79; ROD S&G 92, 100, 118)

Herbicides (Does not apply to Alternative 3)

The following management direction for all herbicide treatments would be incorporated for all of aquatic and riparian species habitat in conjunction with BMP 5.12.

Table 7. Stream classes herbicide exclusion area and distance

Stream Class	Herbicide Exclusion Area and Distances
I	Flag and protect 100 feet + 3 feet for each percent slope of the stream bank in excess of 30 %
II	Flag and protect 75 feet + 3 feet for each percent slope of the stream bank in excess of 30 %
III	Flag and protect 50 feet + 3 feet for each percent slope of the stream bank in excess of 30 %
IV	Flag and protect 5 feet of both sides if channel is dry. If water is flowing in the channel a 25- foot buffer should be used

25. Alternative 2 (Proposed Action): For the protection of Sierra Nevada yellow-legged frog and Yosemite toad, herbicides would be applied using a backpack sprayer in combination with a minimum 25 foot buffer around Yosemite toad suitable habitat (none in Project area), and a minimum 25 foot buffer around SMZ's containing Sierra Nevada yellow-legged frog suitable habitat (Forest Supervisor decision, March 12, 2015).
26. Alternatives 4 and 5: For the protection of Sierra Nevada yellow-legged frog and Yosemite toad, herbicides would be applied using a backpack sprayer in combination with a minimum 500 foot buffer around Yosemite toad suitable habitat, and a minimum 500 foot buffer around SMZ's containing Sierra Nevada yellow-legged frog suitable habitat (Forest Supervisor decision, March 12, 2015).
27. For the protection of California red-legged frog habitat, no herbicide use would occur within 125 feet of identified California red-legged frog suitable breeding habitat (specialist professional opinion).
28. Herbicide application would not occur within 325 feet of perennial streams below 5,000 feet elevation from October 1 through April 30, for the protection of western pond turtle and foothill yellow-legged frog (specialist professional opinion).
29. Within RCAs, no spraying of herbicides would occur when rain events are predicted within 24 hours of implementation to allow for maximum absorption into target vegetation and soils and minimize conflict with amphibian movements (specialist professional opinion).
30. If an incoming rain event is predicted, start spraying at the SMZ boundary and spray outward within the RCA first to allow for maximum drying time prior to rain (specialist professional opinion).

31. Clean up any spills of herbicide immediately as per spill plan.
32. Weed eradication within SMZ's would be by hand removal unless field review can justify reduction of current no-spray buffer (specialist professional opinion).

Stream Drafting

33. For the protection of California red-legged frog habitat, no water drafting sites would occur within 100 feet of identified California red-legged frog suitable habitat (ROD S&G 101).
34. For the protection of California red-legged frog habitat, use only water for dust abatement within 125 feet of identified California red-legged frog suitable habitat (LRMP 39e).

In addition to BMP 2.5 direction, the following drafting guidelines apply for protection of aquatic species and habitat:

35. Water drafting sites would be visually surveyed for amphibians and egg masses each day prior to starting drafting. (ROD S&G 92, 110)
36. A screened intake device and pumps with low entry velocity and suction strainers with screen less than 2mm (1/8 in) in size would be used to minimize removal of aquatic species, including juvenile fish, amphibian egg masses and tadpoles, from aquatic habitats. (ROD S&G #110)
37. The suction strainer would be placed in a canvas bucket to avoid substrate and aquatic species disturbance. (ROD S&G 92, 110)
38. The suction strainer would be inserted close to the substrate in the deepest water available. (ROD S&G 92, 110)

Habitat Restoration Activities

39. Stream crossing structures or crossing locations (including during implementation) would not create barriers to upstream or downstream passage for aquatic-dependent species. (S&G #101)
40. Upon completion of use of stream crossings, damage to the stream course, including banks and channels, would be repaired to maintain a hydrologically stable channel (ROD S&G 100).
41. Materials used for all habitat restoration would come from an approved location (i.e.: rock quarries) (specialist professional opinion).
42. Conduct restoration activities in the fall or when the water table is low to minimize conflicts with local aquatic/riparian species and habitat (specialist professional opinion).

The following are design criteria provided as terms and conditions and conservation measures in the Programmatic Biological Opinion on Nine National Forests in the Sierra Nevada of California for the Endangered Sierra Nevada Yellow-legged Frog, Endangered Northern Distinct Population Segment of the Mountain Yellow-legged Frog, and Threatened Yosemite Toad (File #FF08ESMF00-2014-F-0557). Preceding the text of each criterion is a reference to the associated conservation measure from the biological opinion. The conservation measures below apply to suitable habitat for SNYLF and YT.

Terms and Conditions:

43. From the Programmatic Biological Opinion, page 67:
    a) "2c. If appropriate, the Forest Service [would] move the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad from within Project sites where the nine

Forest programs are implemented to a safe location if they are in danger. (See Appendix C of this Programmatic Biological Opinion)

b) Each Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad encounter [would] be treated on a case-by-case, but the general procedure is as follows: (1) leave the non-injured animal alone if it is not in danger; or (2) move the animal to a nearby safe location if it is in danger. These two actions are further described below.
   - When a Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad is encountered within the Project site, the first priority is to stop all activities in the surrounding area that may have the potential to result in the harassment, injury, or death of the individual. Then, the situation [would] be assessed by a Forest Service biologist or Service-approved biologist in order to select a course of action that will minimize adverse effects to the individual.

c) Avoidance is the preferred option if an individual of the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and/or Yosemite toad is not moving or using a burrow or other refugia. A Forest Service biologist or Service-approved biologist [would] inspect the animal and the area to evaluate the necessity of fencing, signage, or other measures to protect the animal.

d) If appropriate, the, three listed amphibians [would] be allowed to move out of the hazardous situation on their own volition to a safe location. An animal [would] not be picked up and moved based on it not moving fast enough or it is an inconvenience for activities associated with rehabilitation or operation. This only applies to situations where individuals are encountered when they are moving during conditions that make their upland travel feasible. It does not apply to individuals that are uncovered, exposed, or in areas where there is not sufficient adjacent habitat to support the species should the animal move outside the immediate area.

e) Individuals of the three listed species [would] be captured and moved by hand only when it is necessary to prevent harassment, injury, or death. If suitable habitat is located immediately adjacent to the capture location, then the preferred option is relocation to that site. An individual [would] not be moved outside of the radius it would have traveled on its own. Under no circumstances [would] they be relocated to a non-Forest Service property without the landowner's written permission.

f) Only Forest Service biologists or Service-approved biologists may capture the three listed amphibians. Nets or bare hands may be used to capture the animals. Soaps, oils, creams, lotions, repellents, or solvents of any sort cannot be used on hands within two hours before and during periods when the biologist is capturing and relocating individuals. If the animal is held for any length of time in captivity, they [would] be kept in a cool, dark, moist environment with proper airflow, such as a clean and disinfected bucket or plastic container with a damp sponge. Containers used for holding or transporting [would] not contain any standing water, or objects or chemicals that may injury or kill a Yosemite toad, Northern Distinct Population Segment of the mountain yellow-legged frog, and/or Sierra Nevada yellow-legged frog.

g) To avoid transferring disease or pathogens between suitable habitats during the course of translocating the three listed amphibians, Forest Service biologists or

the Service-approved biologist [would] use the following guidance for disinfecting equipment and clothing. These guidelines are adapted from the *Declining Amphibian Population Task Force's Code* which can be found in their entirety at: *http://www.open.ac.uk/daptf/*.

h) At the Project level, if adverse effects occur within suitable habitat, these areas will be restored to pre-existing conditions within one breeding season.

i) Restoration will be implemented within the Project area for areas at risk for erosion, such as those with soil compaction, lowered water tables, and down cutting and gullies (per S&G 122), if there is an adverse effect to suitable habitat for the three listed amphibians."

Conservation Measures:

General:

44. (Gen 1a) Wheeled vehicles off designated routes, trails, and limited off-highway vehicle (OHV) use will be prohibited to reduce the risk of crushing, injuring, or disturbing individuals of the three listed amphibians (per S&G 69).
45. (Gen 1b) Within critical aquatic refuges, occupied habitats, or areas proposed as Critical Habitat, mitigation measures to avoid impacts to the three listed amphibians will be implemented for ground disturbing equipment to reduce the risk of killing individuals and adversely affecting their habitat (per S&G 109). The measures may include avoiding the activity all together.
46. (Gen 1c) Low ground pressure equipment, helicopters, over the snow logging, or other non-ground disturbing actions will be implemented when needed to achieve Riparian Conservation Objectives in the written opinion of the Forest Biologist in order to minimize impacts to riparian conservation areas when operating off of existing roads. The measures include minimizing construction of skid trails or roads for access into riparian conservation areas for fuel treatments, salvage harvest, or hazard tree removal (per S&G 113).
47. (Gen 1d) Prescribed fire treatments will be designed to minimize disturbance to ground cover and riparian vegetation in riparian conservation areas (per S&G 111). Further, no prescribed fires will be lit within riparian vegetation (per S&G 109).
48. (Gen 1e) The use of low velocity water pumps and screening devices for pumps (per S&G 110) will be utilized during drafting for Project treatments to prevent mortality of eggs, tadpoles, juveniles, and adult frogs.
49. (Gen 1f) Pesticide application within riparian conservation areas, for example to control invasive species or promote reforestation, will be limited to situations where the application is consistent with riparian conservation objectives (per S&G 97). The applications will be designed to avoid adverse effects to individuals and aquatic habitats of the three amphibian species where application is within 500 feet of occupied sites (per S&G 98).
50. (Gen 1g) Fuels and other toxic materials will be stored outside of riparian conservation areas and critical aquatic refuges (per S&G 99) to limit the exposure of the three amphibian species to the toxic materials associated with vegetation management activities.
51. (Gen 1h) If management activities are proposed in a CAR or RCA, site-specific mitigation measures will be designed to (1) minimize risk of sediment entry into aquatic systems and (2) minimize impacts to habitat for aquatic- and riparian-dependent species (per S&G 92).

52. (Gen 1i) Mechanical ground-disturbing activities may occur within RCAs and CARs when the activity is consistent with riparian conservation objectives (per S&G 113). Potential adverse effects will be minimized by a requirement to utilize low ground pressure equipment, helicopters, over snow logging or other non-ground disturbing methodologies when operating off of existing roads. BMPs will be applied, and construction of new skid roads or trails into these areas minimized.
53. (Gen 1l) In CARS or RCAs, proposed management activities will increase or decrease frequency and distribution of coarse woody debris so that they more closely match levels within the range of natural variability in order to sustain stream channel physical complexity and stability (per S&G 108).
54. (Gen 1m) Native vegetation cover will be enhanced by various techniques including planting, seeding, soil stabilization, after wildfires to reduce the effects on wildlife and their habitats (per S&G 112). Seeds or cuttings will be obtained from appropriate local native plant species.
55. (Gen 1n) Management activities will not adversely affect water temperatures required for local species, including the three amphibian species (per S&G 96).
56. (Gen 1q) Culverts and stream crossings will not create barriers except for the benefit of the three Sierra Nevada amphibians. Water drafting sites will be located to avoid adverse effects to instream flows and depletion of pool habitat. Where possible, maintain and restore timing, variability and duration of floodplain inundation and water table elevation in meadows, wetlands, and other special aquatic features (per S&G 101).
57. (Gen 1r) Corrective actions will be implemented when needed to restore hydrologic connectivity of aquatic systems that are disrupted by roads (per S&G 100).
58. (Gen 1s) When permits, if any, are re-issued, measures to minimize sedimentation will be evaluated and included as necessary (per S&G 93).

Timber Harvest, Vegetation Management, Fuels Management, and Watershed Restoration

59. (TVFW 1a) Protection needs will be established with appropriate restrictions and mapped prior to commencement of operations (per BMP 1.4). This includes wetlands, [wet] meadows, lakes, springs, streamcourse protection zone widths, etc.
60. (TVFW 1b) A limited operating period may be established to ensure that negative impacts to resources may be avoided; contract provisions can also be used to close down operations during adverse operating conditions (per BMP 1.5)
61. (TVFW 1c) The size and shape of regeneration harvest units will be established to prevent erosion and sediment in order to protect fish, wildlife and other resource needs including the three listed amphibians (per BMP 1.7).
62. (TVFW 1d) An emergency response plan will be created and implemented to prevent contamination of waters from accidental spills of hazardous substances (per BMP 7.4).
63. (TVFW 1e) Water quality and hydrologic considerations as evaluated by a trained earth or water scientist will be incorporated into the timber sale planning process (per BMP 1.1).
64. (TVFW 1f) Fire and fuels management activities in the form of preventative, corrective and administrative measures include the use of prescribed fire or mechanical methods to achieve resource objectives to reduce flooding and erosion perturbations. This may be achieved by managing the frequency, intensity and extent of wildfire (per BMP6.1). Where operations disturb the soil, a vegetative ground cover will be established to prevent erosion and sedimentation (per BMP 1.15)
65. (TVFW 1g) Harvested or managed areas will be revegetated within five years to contain the minimum number, size and species composition specified in regional silvicultural

guides for each forest type. This protects water quality by helping to stabilize soils, increasing ground cover and providing improved infiltration (per BMP 1.23).

66. (TVFW 1i) Forests will maintain desirable stream channel characteristics and watershed conditions to ensure favorable conditions of water quality and quantity and maintain habitat for three listed amphibians. In designing harvest units, size and distribution of natural structures, such as snag and down logs, will be considered to prevent erosion and sedimentation (per BMP 1.2).
67. (TVFW 1j) High-erosion hazard areas will be identified pre-project to adjust treatment measures and prevent downstream water-quality degradation (per BMP 1.3).
68. (TVFW 1k) Unstable lands will be protected by providing special treatment of these areas to avoid triggering mass slope failure with resultant erosion and sedimentation (per BMP 1.6).
69. (TVFW 1o) The Forest Service will ensure that purchasers and their sub-contractors understand and adhere to water-quality BMP prescriptions formulated during the timber sale planning process to prevent and control erosion during timber sale operations. This will be accomplished by setting forth the purchaser's responsibilities in the timber sale contract, and holding the purchaser accountable for actions of their sub-contractor (per BMP 1.13).
70. (TVFW 1q) Erosion will be minimized by ensuring that constructed erosion-control structures are stabilized and working (per BMP 1.20).
71. (TVFW 1r) The Forest Service's formal acceptance of erosion control work by the sale purchaser will be required to ensure the adequacy of required erosion-control work on timber sales (per BMP 1.21).
72. (TVFW 1s) Water quality will be maintained or improved by protecting sensitive areas from degradation which likely would result from using mechanized equipment for slash disposal. Special slash treatment site preparation will be prescribed in sensitive areas (including areas with habitat for the three listed amphibians) to facilitate slash disposal without use of mechanized equipment (per BMP 1.22).
73. (TVFW 1t) Use of mechanized equipment will be prohibited from sensitive areas in meadows, wetlands, Streamside Management Zones, and landslide areas (per BMP 1.22, per BMP 1.8, and per BMP 1.1).
74. (TVFW 1x) The designations of SMZs will minimize the potential for adverse effects from adjacent management activities. Management activities within these zones are designed to improve riparian values and to protect the three listed amphibians. The SMZ will be a zone of total exclusion of activity, or a zone of closely managed activity that acts as an effective filter and absorptive zone for sediment; maintains shade; protects aquatic and terrestrial riparian habitats; protects channel and streambanks; and promotes floodplain stability (per BMP 1.8).
75. (TVFW 1ee) Adverse water-quality impacts associated with destruction, disturbance, or modification of wetlands will be avoided (per BMP 7.3). Factors that will be evaluated include, but are not limited to, water supply, water quality, recharge areas, functioning of the wetland during flood and storm events, flora and fauna, habitat diversity and stability, and hydrologic function of riparian areas.
76. (TVFW 1ff) A water quality monitoring plan will be part of an environmental document, a management plan, or a special use permit, or it will be developed in response to other needs to evaluate the implementation and effectiveness of a management prescription in protecting water quality (per BMP 7.6).
77. (TVFW 1gg) Management by closure to seasonal, temporary, and permanent use will be used to exclude activities that could result in damages to either resources or

improvements, including impaired water quality from roads and trails (per BMP 7.7). Closure to use will occur when the condition of the watershed must be protected to preclude adverse water-quality effects and adverse impacts to the three listed amphibians (per BMP 1.5; per BMP 2.9).

78. (TVFW 1hh) For any new proposed action or activity that may affect water quality, the Forest Service will examine all past, present, and future activities in a sub-watershed that may have a cumulative effect to water quality and beneficial uses (uses specified in water quality standards for each water body or segment), including the three listed amphibians if present in the sub-watershed or downstream. This Cumulative Watershed Effects (CWE) analysis is guided by considerations such as: whether the proposed activity along with other activity in that sub watershed exceed thresholds and are the risks to water quality are too great; whether the action can be deferred to let the watershed recover before implementation; and whether the short-term risks are acceptable, with added mitigation, given the long-term benefits (e.g., mechanical treatment of fuels may cause some short-term risk to water quality which may be acceptable if the treatment can prevent the greater impacts of a future large, high severity wildfire). The CWE process greatly facilitates development of appropriate mitigation measures/design criteria to avoid adverse effects to the three listed amphibians.

Road and Trail Maintenance

79. (2a) To protect hydrologic values and aquatic species water source development and utilization will follow specific criteria for the location of drafting sites, procedures for drafting operations, as well as approaches and drafting pads (per BMP 2.5).
80. (2c) Measures described in BMP 2.11 to prevent adverse effects from fuels, lubricants, cleaners, and other harmful materials that are discharged into nearby surface waters or infiltrate through soils to contaminate groundwater resources on skin-respiring amphibians resulting from equipment refueling and servicing will be implemented.
81. (2d) To protect water quality during road maintenance and operations, 31 practices related to road inspection, maintenance planning, and operations will be implemented as appropriate based on local site conditions (per BMP 2.4).
82. (2e) Erosion, sedimentation, and chemical pollution that may result from snow removal and storage activities will be prevented or reduced (per BMP 2.9).
83. (2f) Road construction and reconstruction will be designed to minimize erosion and sediment delivery (per BMP 2.3).

2.1.6.3. Botanical Resources and Invasive Weeds

84. Along streams with occurrences of Rawson's flaming trumpet (*Collomia rawsoniana*), a riparian-dependent FS sensitive plant; patches of plants would be flagged for avoidance if they are not protected adequately by SMZs. Flagging would be green lime-glo and white tied together. Streams affected are: Fish Creek, Slide Creek and tributaries, Rock Creek and tributaries, and an unnamed perennial stream flowing into Mammoth Pool (SNF 1992 LRMP S&G #68 and SNFPA ROD S&G #125).
85. FS sensitive plants of rock outcrops and adjacent sand or gravel, such as Yosemite lewisia (*Lewisia disepala*) and Mono Hot Springs evening primrose (*Camissonia sierrae* ssp. *alticola*) would be flagged for avoidance with green lime-glo and white flags tied together if necessary to ensure that ground-disturbing activities do not take place in occupied habitat (SNF 1992 LRMP S&G #68 and SNFPA 2004 ROD S&G #125).

86. Equipment and vehicles may be driven or parked on granitic rock outcrops and associated gravel and sandy soil only after the Sale Administrator consults with the FS botanist. This protects known populations and suitable habitat for the following species: Mono Hot Springs evening primrose, Yosemite lewisia, and Kellogg's lewisia (*Lewisia kelloggii* ssp. *kelloggii*). Log decks, burn piles and other stacked materials should not be placed on these areas for the same reasons. (Derived from SNF LRMP S&G #68 and SNFPA 2004 ROD S&G #125).
87. As much native material ground cover should be left on the ground as practicable, not only for erosion control purposes but also as a source for seed and propagules for native vegetation (FSH 2609.26 – 40.3 Botanical Program Management - Revegetation).
88. Any erosion control material brought in from outside of the Project area needs to be analyzed by appropriate specialists for its efficacy and risk of weed spread. This includes not only plant material but also manufactured materials, such as geotextiles or rock/fill brought in from other areas. (SNFPA ROD S&G #40, #42 and #45).
89. In case new occurrences of sensitive plants are found during the lifespan of this Project, new Controlled Areas would be flagged for avoidance with lime-glo and white flagging; locations GPS-ed, and the information promptly provided to the Sale Administrator (SNF 1992 LRMP S&G #68).
90. If additional invasive weed locations are found during field surveys in 2015 and beyond, they would be GPS-ed, flagged for avoidance with orange tape marked with the words "Noxious Weeds," and the locations given promptly to the Sale Administrator who will notify the contractor (SNFPA 2004 ROD S&G #40 and #48).
91. Ensure that all equipment used for removal of trees, skidding, fuels management, and/or road maintenance is clean (free of soil, seeds, plant parts, and propagules) before being brought into the Project area. This would minimize the importation of new weeds into the burned area. (SNFPA 2004 ROD S&G #39).
92. If equipment or off-road vehicles are used within the areas of mapped medusahead or other invasive weeds, they would be washed upon exiting those areas and prior to travel to new, uninfested areas. Washing locations would be approved by the Sale Administrator after consultation with Forest Service botany and hydrology specialists. (SNFPA 2004 ROD S&G #39).

2.1.6.4. Cultural Resources

Project implementation would comply with the stipulations of the *Programmatic Agreement Among the USDA Forest Service, Pacific Southwest Region (Region 5), California State Historic Preservation Officer, Nevada State Historic Preservation Officer, and Advisory Council on Historic Preservation Regarding the Processes for Compliance with Section 106 of the National Historic Preservation Act for Management of Historic Properties on the National Forests of the Pacific Southwest Region* (Regional PA), dated 2013.

This Project meets Stipulation 7.8(b) (2), Undertakings with Historic Properties. Per Stipulation 7.8(b)(2)(a), protection measures specific to individual historic properties derived from the Approved Standard Protection Measures (ASPMs) (Regional PA Appendix E) will be described in the Project cultural resource management report developed for this Project.

93. The proposed Project area will be surveyed for archaeological and historic resources. However, should additional salvage or hazard timber be identified in future years outside

of the proposed action area, contact the District Archaeologist to ensure that there has been adequate identification of historic properties prior to Project activity.

94. Prior to initiating Project activities, contact the District Archaeologist to ensure appropriate protection measures for cultural resource sites are in place and understood.
95. When necessary to protect historic properties, avoid historic properties with ground disturbing activities (i.e. the use of ground-based mechanical equipment, planting, etc.), in accordance with the Class I: Avoidance, of the Regional PA.
96. Allow certain Project activities within specific historic property boundaries, in accordance with the Class II ASPMs. Certain proposed activities lack the potential to adversely affect the character of historic properties, and include but are not limited to the following:
    - For certain historic properties, fall and remove hazard and salvage trees within the historic property boundaries to protect life and property, and reduce the dead fuel accumulation which may pose further fire risk to cultural components. Removal of roadside hazard trees from within historic property boundaries may take place across the Project area. This work within historic property boundaries on a site-specific basis would be approved in advance by contracting officials after they consult with the District Archaeologist in accordance with ASPM 2.2(a) (1-6). Removal of vegetation and fuels mechanically or by hand where it would not affect at risk historic properties (ASPM 2.2(b) (A-K)), as approved on a site-specific basis in advance by contracting officials after they consult with the District Archaeologist.
    - For certain historic properties, roads may be used through historic properties in accordance with ASPM 2.1(c) (Regional PA).
97. The Sale Administrator shall approve landings, borrow sources, and temporary roads only after consultation with the District Archaeologist (Professional Judgment 2015, see Design Criterion 93 above)).
98. Harvest activities of hazard trees within and immediately surrounding the Rock Creek and Fish Creek Campgrounds will avoid historic campground features and be implemented in accordance with ASPMs found in the Regional PA (Regional PA, ASPM 2.2(a).
99. All repairs/replacements to campground, recreation (i.e., trails), and special use facilities, if damaged during Project implementation, will need to be approved by the Sale Administrator after consulting with the District Archaeologist prior to repair/replacement and may require consultation with the California State Historic Preservation Officer SHPO) prior to repair/replacement (see 2.1.6.8 *Recreation and Scenery* design criteria 149; Regional PA, 2.0 Class II).
100. In response to 2.1.6.9 *Recreation and Scene*ry design criteria 142,143, and 149, the District Archaeologist would be consulted prior to implementation (Regional PA, ASPM 2.1(b).
101. The District Archaeologist shall be consulted for movement of equipment across and repair of designated trails (e.g., French Trail), prior to Project implementation and subsequent repair, and may require consultation with the SHPO prior to implementation (Regional PA, ASPM 2.1(a)).
102. Road maintenance and reconstruction activities on historic railroad grades converted to FS system roads shall comply with Regional PA, ASPM 2.1(a) and be approved by the Sale Administrator after review and consultation with the District Archaeologist prior to contract preparation and shall comply with the following (Regional PA, ASPM 2.2(d)):
    a) Brush disposal piles generated during roadside clearing shall not be piled within archaeological sites or within or near features of historical sites;

b) Equipment shall not park or drive on railroad features (e.g., berms, through-cuts) nor turn around outside existing turn-outs on system roads;
c) No widening of existing road templates;
d) All blading shall remain within existing road prism. Equipment shall not cut into side banks or berms;
e) Through-cut features shall remain intact and shall not be cut off at either end. Bladed material shall be pushed past the feature and then off the road;
f) No placing lead-off ditches through berms, through-cuts, or other features;
g) When cleaning culverts or drainages, existing headwalls shall not be impacted. Drainage structures shall be accessed only where there are no existing railroad features;
h) Any existing features that require work shall be re-built with in-kind material and design.

103. An archaeologist shall monitor all harvest and hazard tree removal activities within and around cultural resource sites during implementation. An archaeological monitoring report will be required for each activity or group of activities (Regional PA, ASPM 1.5).
104. In the event of inadvertent effects or new discovery during implementation, the Forest would comply with Stipulation 7.10 of the Regional PA regarding the notification and consultation process.
105. In response to 2.1.6.5 *Fire and Fuels*, design criteria and 117 and 118, the District Archaeologist would be consulted prior to implementation (Regional PA, ASPM 2.1(b).
106. The temporary road through the Mile High Campground may not be used during Project activities (Regional PA, Stipulation 6.0; ASPM 1.0; SNFPA ROD 2004: VIII.E.).
107. In consultation with the Sale Administrator, the District Archaeologist would notify North Fork Rancheria of Mono Indians of California (NFR) of the timing and location of timber sale activities, as soon as this knowledge is available to the Forest Service (SNFPA ROD 2004: VIII.E).
108. Each year, the Forest Botanist and District Silviculturist would consult with the District Archaeologist to ensure that NFR tribal members are notified ahead of time of the locations and timing of herbicide spraying (SNFPA ROD 2004: VIII.E; see also *2.1.6.7. Herbicide* design criteria).
109. See 2.1.6.7. *Herbicide* design criteria for additional protective measures for activities of interest to Native Americans.
110. Other Cultural Resources: Traditional cultural properties, locations of contemporary Native American gathering, and other cultural resources identified through consultation with Native American tribes and individuals would be protected through avoidance by Project activity, or managed through Project implementation and consultation to enhance the resource (SNFPA ROD 2004: VIII.E.; Regional PA 6.0).

The following design criteria apply to an area of tribal concern (ATC) within the Project Area. As the location is confidential, the Sale Administrator, Fuels Specialist, and Silviculturist would consult with the District Archaeologist prior to implementation (SNFLMP 1991 S&G #197, #198; Regional PA 6.0):

111. A tracked loader would utilize only existing skid trails and roads and the existing landing within the ATC. Trees would be directionally hand-felled towards these skid trails and roads and cut into logs (lengths would be either 16 feet or 32 feet long) that the loader would be able to reach, lift, and move on to the skid trail with minimal soil disturbance. The tracked loader would then skid the trees along the existing skid trail to

the FS system road. The tracked loader would not travel off the FS system road, existing skid trails or landing within the ATC.

112. The existing skid trails and landing would be clearly delineated with flagging to ensure operators do not travel off them.
113. All logs that are out of the reach of the loader (more than 40 feet on both sides of the skid trail) would be hand-felled and the slash lopped and scattered to less than 18" tall to create a consistent burnable fuel bed. The fuels would then be treated by jackpot burning.
114. All of these activities would be monitored by an FS Archaeologist.

2.1.6.5. Fire and Fuels

To sustain large woody debris needs for terrestrial and aquatic wildlife, and soils habitat the following would be applied.

115. Where feasible, in treated areas along roads outside of 1st and 2nd entry areas:
    a) Within 300' either side roads slash concentrations will be either mechanically (generally on slopes <35%) piled/burned or hand piled/burned (generally on slopes >35%), crushed and/or jackpot burned or removed for biomass.
    b) Slash would be scattered into openings and-dispersed away from residual trees.
116. All slash will be bucked to a minimum 10 foot bucking length to facilitate piling operations.
117. Activity created fuels within developed recreation sites, campgrounds and trailheads will be treated by piling and pile burning, chipping or biomass removal.
118. If there are areas of concern, site-specific treatments will be prescribed for slash treatment after consultation with other specialists.
119. In 1st and 2nd entry treated areas: limit surface fuel loading to 10-30 tons per acre (the majority being in fuels less than 9 inches in diameter). The areas in road hazard treatment units that intersect these areas would have the slash cleanup completed as part of the overall post-harvest slash cleanup.

2.1.6.6. Forest Health/Vegetation (Silviculture)

All cut conifer stumps greater than 3 inches stump diameter would be treated with an EPA registered borax fungicide, such as borax, for the prevention of the spread of annosum root disease within Mile High Vista and Rock Creek and Fish Creek Campgrounds. Borax would be applied by hand in an approved granular form within one hour of the stumps being cut. The fungicide would not be applied when it is raining. All Forest Service policies and practices, and California regulations relating to pesticide use would be followed including developing a spill plan for the borax. (R5 FSM 2303 & R5 FSH 3409.11)

120. To reduce the threat of insect attack, all green pine logs created as a part of harvest operations would be removed from the sale area as either logs or biomass material within 6 weeks of creation.
121. Un-utilized green pine material greater than 3" would not be concentrated but spread to dry quickly or chipped and spread, unless needed for terrestrial wildlife habitat (large woody debris) (Shultz 1987). Upon drying out, slash concentrations would be piled and burned. Refer to Terrestrial Wildlife DC section.

122. Green pine logs greater than 3 inches in diameter that are created between July 1st and October 15th and left in the stand would not exceed 8 feet in length.
123. Commercial thinning operations taking place before July 1st or after October 15th in green pine stands would require additional measures to minimize creation of green pine slash concentrations. Additional bucking of slash may be needed to minimize creation of favorable insect breeding habitat. Any green pine logs greater than 3 inches in diameter created after October 15th or before July 1st left in the stand should not exceed 4 feet in length. Pre-commercial thinning of pine stands should not take place before July 1st or after October 30th each year. Please refer to Terrestrial wildlife Design Criteria.
124. Where whole tree yarding is utilized, careful consideration must be given to the protection of the residual green trees from damage (Shultz 1987, Flowers 2007, Murray 2012).
125. Rub trees (previously designated for removal) and/or rub logs should be retained where needed to minimize damage. These would then be removed upon completion of yarding.
126. Skid trails should be as straight as possible and approved prior to skidding. Landing size should be kept to a minimum especially in areas where additional trees must be felled to create landings.
127. To minimize landing size within stands with residual trees, logs/biomass should be removed as quickly as feasible from landings during skidding operations and not allowed to accumulate.

2.1.6.7. Herbicides

In addition to the following criteria, see 2.1.6.2 for design criteria for herbicides specific to aquatic and riparian habitats and their associated species.

128. All applicable pesticide laws and label restrictions would be followed to ensure human health and safety (BMP 5.8).

129. All manufacturers label instructions for glyphosate, R-11, and color fast purple dye shall be followed.
130. Herbicide applications shall be accomplished using backpack sprayers by workers on foot.
131. Spray operations shall cease when sustained average wind speeds exceed five miles per hour. Spray operations shall momentarily cease when wind gusts exceed seven miles per hour.
132. Spray operations shall cease if precipitation is occurring or if it is predicted with 70% certainty within 6 hours. Spraying may not resume after a precipitation event until the target vegetation has dried, typically 24 hours after the end of any precipitation that wets the target species.
133. To help assure no effects occur to human health and safety, all areas treated with glyphosate would be signed, warning that herbicide has been applied and that plant products should not be gathered for food or medicine for 30 days.
134. Herbicide applications for invasive weeds shall target only the weeds of concern to the extent practical. For example, herbicide would be “sprayed-to-wet” on medusahead plants or patches of plants and non-target native or desirable non-native plants would be avoided.
135. Non-work areas within herbicide treatment areas shall be flagged for avoidance (e.g. SMZs, controlled areas for sensitive plants).

136. In order to maintain and recruit oaks in the recovering landscape for wildlife habitat and native plant diversity, seedlings and stump-sprouting oaks would be avoided during spraying as per guidelines currently under development by the IDT (guidelines would ensure adequate oak retention and recruitment). (2004 SNFPA ROD, S&Gs 18, 19, 20, 26).
137. Plants of significance to local Native Americans (e.g. deer grass, sourberry, redbud, wormword, elderberry, willow) shall be carefully avoided when using both herbicide and manual methods.
138. Herbicides would not be sprayed within known Native American gathering sites; these gathering sites would be flagged for avoidance and any invasive weeds would be hand-pulled. Throughout the duration of the Project, the FS botanist and archaeologist (with silviculturist as needed) would continue ongoing field visits to these sites with tribal members to coordinate precise locations that would not be sprayed.

2.1.6.8. Range

139. Control livestock grazing to achieve successful reforestation. Mitigate or otherwise protect reforestation areas from livestock until seedlings are capable of withstanding any permitted grazing (USDA 2014, FSM 2400).

2.1.6.9. Recreation and Scenery

140. Hazard and dead burnt trees, including trees less than 10” dbh, within view (up to 100-feet) of Minarets Road, Mammoth Pool Road, French Trail and recreation sites (i.e., Fish Creek Campground, Rock Creek Campground, Shakeflat Trailhead, and Mile High Vista) would be felled to mitigate the visual impacts of the burned skeleton trees (SNF LRMP S&G #25 and #26a).
141. Tree stumps that are within view (up to 150-feet) of Minarets Road, Mammoth Pool Road, French Trail and within recreation sites (i.e., Fish Creek Campground, Rock Creek Campground, Shakeflat Trailhead, and Mile High Vista) would be cut as low to the ground as site conditions allow (e.g., terrain, rock outcroppings) but not to exceed 6-inch heights, including 6-inch heights from the uphill side (SNF LRMP S&G #25 and #26a).
142. Burn piles, landings, and staging areas would not be located within recreation sites (i.e., Fish Creek Campground, Rock Creek Campground, Shakeflat Trailhead, and Mile High Vista); while recreation sites are opened to the public (SNF LRMP S&G #25 and #26a).
143. Burn piles, landings, and staging areas would be allowed within recreation sites (i.e., Fish Creek Campground, Rock Creek Campground, Shakeflat Trailhead, and Mile High Vista); while recreation sites are closed to the public and upon Sale Administrator consultation with the Landscape Architect and Assistant District Recreation Officer. By opening dates of each recreation site, all equipment would be removed and any ruts and damages caused from the staging areas would be restored. Any slash or fuel treatments would be promptly completed so as to ensure the recreation sites are clear of piles and landings, including accumulated slash, limbs, and logs (SNF LRMP S&G #25, and #26a).
144. Burn piles within view (up to 150- feet) of Minarets Road, Mammoth Pool Road, French Trail and recreation sites (i.e., Fish Creek Campground, Rock Creek Campground, Shakeflat Trailhead, and Mile High Vista) would burn with more than 90 percent consumption. If 90 percent consumption is not reached (and the remaining fuels still meet the fuels objectives), the remnant slash would be scattered. Burn piles would be burned as

soon as possible during the low-use recreation season to reduce impacts to forest visitors. Where feasible, burn piles would be located where they would not be visually evident to the casual forest visitor (e.g., behind vegetation or landform for screening) (SNF LRMP S&G #25 and #26a).

145. Landings within view (up to 150-feet) of Minarets Road, Mammoth Pool Road, French Trail and recreation sites (i.e., Fish Creek Campground, Rock Creek Campground, Shakeflat Trailhead, and Mile High Vista) would be restricted to existing openings whenever possible to minimize new landings and avoid removal of live trees, creation of skid trails, and road clearing. Landing sizes would be minimized and the edges of the landings would be irregularly shaped, feathered and undulated to create a near-natural appearance and mimic the natural openings in the surrounding landscape. Landing piles would be burned as soon as possible during the low-use recreation season to reduce impacts to forest visitors. Where feasible, landings would be located where they would not be visually evident to the casual forest visitor (e.g., behind vegetation, landform, or rock outcroppings for screening). Upon completion, landings would be cleaned-up and restored using BMPs (SNF LRMP S&G#25 and #26a).
146. Within view (up to 150-feet) of Minarets Road, Mammoth Pool Road, French Trail and recreation sites (i.e., Fish Creek Campground, Rock Creek Campground, Shakeflat Trailhead, and Mile High Vista), previously constructed temporary roads would be re-opened whenever possible to minimize new temporary roads. Temporary roads would be constructed in a manner that closely duplicates the existing contour lines, limiting the amount of earthwork. Excessive cut and fill slopes for road construction would be avoided. Straight linear road construction, rock outcrops, and/or sensitive areas would be avoided. Upon completion, where the road access is no longer necessary to implement the Project, the temporary roads would be closed with naturally-shaped earth mounds, native boulders, or logs to discourage use and restored using BMPs as described in the Transportation Design Criteria. (SNF LRMP S&G #25, #26a, and #26e).
147. Where skid trails are within view (up to 150-feet) from Minarets Road, Mammoth Pool Road, French Trail and recreation sites (i.e., Fish Creek Campground, Rock Creek Campground, Shakeflat Trailhead, and Mile High Vista), the skid trails would be covered with pine needles, duff, or small woody debris to minimize visual impacts, when material is available within the Project area. The following BMPs associated with skid trails, BMP 1.10 Tractor Skidding Design and BMP 1.17 Erosion Control of Skid Trails would be applied (SNF LRMP S&G#25, #26a, and #26d).
148. During Project activities, access to dispersed camping areas and/or dispersed use areas that are on designated roads or designated trails would continue contingent upon the safety of the public (SNF LRMP S&G #15).
149. Any damage to building structures such as fire rings, tables, bulletin boards, site barriers as a result of Project activities within recreation sites (i.e., Fish Creek Campground, Rock Creek Campground, Shakeflat Trailhead, and Mile High Vista) would be repaired or replaced to pre-project conditions prior to opening recreations sites to the public (SNF LRMP S&G #16).
150. After Project implementation, vegetative or other natural barriers would be installed along designated roads within the Project area to discourage unauthorized motorized routes in locations deemed necessary by District Assistant Recreation Officer (SNF LRMP S&G #18).

2.1.6.10. Soils

151. Lop and scatter fuels below rock outcrops that have the potential to generate runoff into management activity areas and cause erosion, loping and scattering fuels within these areas will maximize soil cover and surface organic matter retention (USDA, 2012).
152. Conduct mechanical equipment operations when the soil is sufficiently dry in the top 12 inches to prevent unacceptable loss of soil porosity; (Peterson, 2009, USDA, 2012 & Wagenbrenner, 2014).
153. Operating out of the normal period during times of increased moisture content on fine textures soils subsoiling will be required in areas where compaction has been identified. Subsoiling will be accomplished by equipment that will lift and fracture the soil by vertical and lateral shattering, leaving soil loosened through the full width and depth of the compacted layer with the topsoil remaining substantially in place rather than being inverted (Kees, 2008).
    - Subsoiling equipment will be required to utilize winged tip shanks over conventional shanks without winged tips (Kees, 2008).
    - Subsoiling depth will be determined by qualified soil scientist in the field, a lesser depth will be required if rocks or other limiting site conditions are encountered (Kees, 2008).
    - Subsoiling shall be limited to periods when soil dryness will result in crumbled soil, avoiding the formation of large clods (Kees, 2008).
154. Subsoil skid roads trails in areas where soil compaction exceeds 15% of a treatment area (USDA, 2012).
155. Excluding mastication, limit mechanical operations where sustained slopes exceed 35%, except where supported by on-the-ground interdisciplinary team evaluation (USDA, 1991 & Peterson, 2009).
156. Limit mastication operations to slopes less than 50%. Minimize soil displacement and reduce the risk of soil erosion by smoothing or water barring ruts or trenches exceeding 6 inches in depth and 25 feet in length on slopes greater than 35% (BMP 5.2).
157. Soil cover needs to be maintained at an average accumulation of 50% on slopes less than 35% to minimize soil erosion and uphold surface organic matter accumulation; soil cover components include the 1 to 100-hour fuels with some 1,000 hour fuels up to 10 inch diameter. Within treated areas on slopes greater than 35%, 70% soil cover needs to be maintained. Where shrub species predominate, attempt crushing prior to piling to create small woody fragments left scattered over the site for soil cover and erosion protection (USDA, 1991, Larsen, 2009 & USDA, 2012).
    - Soil cover includes ash, organic surface materials, living vegetation less than 3 feet tall (grasses, forbs and low growing shrubs), surface rock fragments larger than ¾ inch or where needed applied mulches (USDA, 2012).
    - Some soil and ecological types may not be capable of producing 50 percent soil cover because of naturally low productivity (USDA, 2012).
158. Endlining within SMZs, near rock outcrops or on steeper slopes where surface gouges or trenches form water bar soil displacements if they exceed 6 inches in depth and 25 feet in length (BMP 1.9).
159. Within treatment areas that are whole-tree yarded backhaul slash onto skid trails for soil cover and surface stabilization (Wagenbrenner, 2014).
160. Maintain 10 to 30 tons per acre of coarse woody debris to provide desirable quantities for soil productivity and protection (Brown, 2003, USDA 2004 & USDA, 2012).
    a. Coarse woody debris is considered as any dead standing or downed pieces larger than 3 inches in diameter (Brown, 2003).

161. After timber harvest, grapple pile, crush, jackpot, and/or lop and scatter on slopes greater than 25% while still maintaining fuels objectives, generated materials left behind will help achieve or maintain recommended soil cover (USDA, 2004 & Peterson, 2009).
162. Provide for road surface stabilization (aggregate) on roads over 5%-grade that are located on sensitive soils within a Streamside Management Zone (SMZ), and in watersheds with high Cumulative Watershed Effects (CWE) potential. Sensitive soils include; Auberry, Holland and Ultic Haploxeralfs soil families (USDA, 1991).

2.1.6.11. Terrestrial Wildlife

163. Harvest activities may occur in PACs or portions of fisher den site buffers that have been rendered unsuitable as determined by the wildlife biologist and documented within a Biological Evaluation/Biological Assessment. Outside of wildland urban interface (WUI) defense zones, salvage harvests are prohibited in PACs and known den sites unless rendered unsuitable(S&G #16).
164. Suitable habitat in the Project area and within ¼ miles of the Project area would be surveyed in the spring of 2015 and subsequent years depending on protocol, to determine occupancy and pair status of spotted owls, according to the Region 5 survey protocol. If repeated occupancy occurs or a nest site is located, new PACs would be established in accordance with the SNFPA 2004 (S&G #33 and #34).
165. A Limited Operating Period (LOP) would be in effect from March 1st through August 15th within ¼ mile of spotted owls nest site or activity centers. If the nest site cannot be determined, the LOP would be within ¼ mile of an established PAC where repeated occupancy detections occur (S&G 75).

Fisher

166. When selecting snags for retention in high and moderate burned areas, retain clumps of snags adjacent to live trees (ponderosa pine is the priority) that are near potential fisher resting sites with a variety of decay classes near Class 1 SMZs within the elevation band of 3500 feet to 6800 feet.
167. Also retain snags in higher quality sites containing existing standing culls or snags that are dead before the fire.
168. To minimize disturbance to fisher during the denning season, an LOP would be in effect from March 1 through June 30 restricting extensive mechanical activities such as commercial salvage logging between 3500-6500 feet in elevation.

Snags

169. Snags would be retained at four per acre averaged over each ten acres (i.e. a 10-acre unit needs 40 snags). They would be selected for longevity on the landscape for wildlife species.
170. Snags picked within or on the edges of the units where removal of Fire-Affected trees would occur in stands would meet the following criteria:
171. Snags, at a minimum, must be 20 feet tall and at least 15 inches in dbh.
172. Snags 30 inches in diameter or more are the top priority for retention. Snags below this diameter may be selected over size if they have ‘defects’ (unique branching such as large limbs, witches brooms, fork-tops, etc.; cavities catfaces, swollen boles, etc.). The largest trees with defects would be selected. If there are no trees with defects, then the largest trees in or adjacent to the units would be selected.

173. Design Project to implement and sustain a generally continuous supply of snags and live decadent trees suitable for cavity nesting wildlife across a landscape. Use snags larger than 15 inches dbh to meet this guideline. Snags should be clumped and distributed irregularly across the treatment units (S&G 11).
    a) In mixed conifer and ponderosa pine types - four of the largest snags per acre
    b) Red fir types - six of the largest snags per acre
    c) Groups of snags would be retained near Class I streams, edges of brush fields, and meadows to provide perches and cavities.

Downed Woody Material

174. Where available, three of the five required down logs per acre (SNF LRMP) would be in the largest size classes, in decay classes 1, 2, and 3 (SNFPA S&G 10) (SNF LRMP 64d) and at least 20 inches in diameter and 20 feet in length would be retained (North Kings Deer Herd [NKDH] Management Plan, Bertram 1984).
175. Avoid disturbing existing large down wood, greater than 20 inches in diameter and 20 feet long.
176. Provide for additional down woody material by leaving felled cull hazard trees (dead trees with less than 25 percent sound wood) on site, as needed to meet the three logs per acre requirement for down wood.

Mule Deer

177. An LOP would be in effect from May 1 through June 15 restricting intensive activities such as salvage logging in the area just south of Mammoth Pool between Shakeflat Creek and Forest Road 6S25. Mule deer stage in this area prior to crossing Mammoth pool. Affected units include: Plantation P900, First Entry Units 1m, 6m, 7m, 9m, 10m, 12m, 16m, 17m, 18m, 19m, 24m, 27m, 28m, 91m, 101m, 711m, second entry units, roadside hazard, DFPZ, and powerline buffer treatments.
178. Where it exists, vegetative screening would be retained to reduce disturbance and provide hiding cover adjacent to meadows (SNF LRMP S&G 48). Vegetation screening is only required in key deer areas adjacent to maintenance level 3, 4, and 5 roads (SNF LRMP S&G 48). Optimum cover would screen 90 percent of an adult deer at 150 feet from the road edge.

2.1.6.12. Transportation (National Forest Road Systems)

179. All NFS roads would be maintained to standards established in the Forest Service Handbook.
180. Road maintenance and reconstruction activities would be performed to support Project access needs. Project design would insure drainage structures are functional and stable to prevent potential resource damage and degradation of water quality. (S&G #78, #79, #124, #206 and BMPs; 7709.58 (USDA FS 1992b).
181. For dust abatement, water, oil, or magnesium chloride would be used. To minimize the potential for water quality impacts, compounds other than water would not be applied within 25 feet of stream channels, or in roadside or lead-out ditches (S&G #206).
182. Temporary roads required for unit access would be closed upon completion of use. Culverts would be removed, waterbars would be constructed, the entrance would be blocked with a log and dirt berm, and the entrance would be disguised with brush to discourage public use (see BMPs 1.13, 1.17, 1.19, 2.2, 2.7, and 2.8).

183. Perform a final field review of Project roads to determine reconstruction needs prior to Project activities. Where economically feasible, place aggregate on existing native surface roads located on sensitive soils within Streamside Management Zones (SMZ) that are in watersheds with high Cumulative Watershed Effects (CWE) potential.

2.1.6.13. Watershed/ Hydrology

Forest policy and regulations to protect water quality and ensure watershed health are detailed by Best Management Practices (BMP's) described in FSM 2509.22 - Soil and Water Conservation Handbook Chapter 10 - Water Quality Management Handbook, (USDA, 2011), the Riparian Conservation Objective Standards and Guides as set forth in the Sierra Nevada Forest Plan Amendment (USDA, 2004), the SNF Land and Resource Management Plan (LRMP) (USDA, 1991), and FSM 2509.22, SNF Supplement No. 1., (USDA, 1989) . General Project BMPs with their corresponding design measures are listed in Appendix 1.

BMPs would be implemented through Project contract specifications, maps, and administration, and adhered to during Project activities, in order to protect water quality (SNF LRMP S&G #124). Implementation of BMPs (FSH 2509.22 Ch. 10, R5 Supplement 2011) is required to meet the requirements of the Clean Water Act and agency obligations to the State Water Quality Control Board; including the submission of an Application for Conditional Waiver for Timber Harvest Activities to the Central Valley Regional Water Quality Control Board.

184. Applicable Riparian protection buffers (LRMP S&G #70 and SNFPA ROD S&G #91) would be designated. SMZs (USDA FS 1989), Riparian Management Areas (RMAs) (USDA FS 1989), and Riparian Conservation Areas (RCAs) (USDA FS 2004) would be designated as follows:

Table 8. USFS RCA, SMZ, and RMA widths for the action alternatives

Feature Type	RCA Width	Stream Class	Stream Order	SMZ Width[13]	RMA Width
Perennial Streams	300 feet	I[14]	≥4	At least 100 feet	100 feet
Seasonally Flowing Streams	150 feet	II	3	At least 75 feet	N/A
		III	2	At least 50 feet	
		IV	1	0 - 25 feet[15]	
		V			
Streams in Inner Gorge	Top of Inner Gorge	Varies			
Special Aquatic Features (fens, bogs, springs, seeps, lakes, ponds, wetlands, etc.)	300 Feet	N/A		N/A	100 Feet

[13] All SMZ widths include an additional three feet for each percent slope above 30 percent. SMZs are applied to each side of streams, so if treatments are located on both sides of a perennial stream, there are 100 foot SMZs on both sides for a total mechanized exclusion area of 200 feet, plus any needed slope adjustments.

[14] Class I streams are not always perennial. Intermittent streams with certain characteristics can also be Class I.

[15] Application of the Class IV-V SMZ buffer is left to the discretion of the TSA: ephemeral Class V swales would have no SMZ buffer; ephemeral Class IV-V drainages with defined bed-and banks would have a 25 foot buffer.

Perennial Streams with Riparian Conditions extending more than 150 feet from edge of stream bank		I	At least 100 Feet	
Seasonally Flowing streams with riparian conditions extending more than 50 feet from edge of stream bank				N/A

Soil and Water Quality Protection

185. To prevent CWE's, soil protection measures should be implemented in all subdrainages identified as exceeding the upper threshold of concern. All soil design criteria are presented in the soils report for this Project and included in the EA. The design criteria from the soils will be essential in preventing accelerated erosion and sediment delivery to streams:
186. Limit tractor piling in those subdrainages (506.0051, 506.1001, 523.0021, 523.0028, 523.0030, 523.0063, 523.0064, 523.7052) where Cumulative Watershed Effects (CWE) are a concern and use a grapple piler, especially on slopes >25% (USDA, 1991).
187. Treatment units u34m, u46m, u55m, u56m, u57m, u59m, u60m, u61m, u62m, u64m, u67m, u68m, u70m, u71m, u72m, u84m, u92m, u100m, u109m, u461m, u463m (including roadside hazard, DFPZ's, and plantations) in Subdrainages 523.6051, 523.7001, and 523.7051, will require additional mitigation measures to prevent a CWE response (P. Robichaud, personal communication, March, 2015). These measures include:
    a. The use of a grapple piler on slopes over 15% for site preparation and clean up.
    b. Any skid trail that is within 25-feet (or less) of an SMZ should have:
        - Decreased waterbar spacing to one-half of the normal BMP specification. For example, if the normal waterbar spacing (based on soil and slope conditions, BMP 1.17) is 45-feet, it would be reduced to 22.5-feet. Decreased waterbar spacing should be used from the SMZ boundary to a 50-foot distance along the skid trail away from the SMZ boundary or, if the skid trail parallels the SMZ, for the length that the skid trail is within 25-feet of the SMZ.
        - >90% ground cover of slash and/or certified weed-free straw mulch[16] distributed on the skid trail from the SMZ boundary to a 50-foot distance along the skid trail away from the SMZ boundary or, if the skid trail parallels the SMZ, for the length that the skid trail is within 25-feet.
        - In areas of high soil burn severity (i.e., RAVG mortality of >75%) where soil cover is less than 50%, waterbar outlets should have slash and/or certified weed-free straw mulch distributed at the outlet for a distance of 50-feet downslope to prevent accelerated erosion on the adjacent unprotected hillslopes.

Dust Abatement

[16] A Forest Service botanist should be consulted prior to the procurement of any straw mulch to ensure that the product purchase meets USFS specifications for weed protection.

188. Water, oil, or magnesium chloride would be used to control dust on haul routes. To minimize the potential for water quality impacts to result from the use of dust abatement materials other than water, the following measure would be incorporated: Compounds other than water would not be applied within 25 feet of stream channels, or in roadside or lead-out ditches (S&G #206).

Landings and Temporary Roads

189. The hydrologist and/or fisheries biologist should be consulted prior to constructing a new temporary road or enlarging a landing in an RCA (SNFPA S&G 92, 113). Existing temporary roads and landings located in SMZs should be inspected by the hydrologist and/or fisheries biologist and sale administrator prior to use and again prior to acceptance to ensure that BMPs are properly implemented (SNFPA S&G 113).

Stream Crossings

190. The greatest potential for the action alternatives to affect the hydrologic connectivity of streams and aquatic habitat exists at stream crossings. To minimize the potential for Project-related effects on hydrologic connectivity, existing crossings would be used whenever possible. In the event that it is necessary to construct a temporary crossing, the methods used for construction would be selected to avoid or minimize detrimental soil and vegetation disturbance and to maintain hydrologic connectivity between upstream and downstream features. All temporary crossings would be removed following the completion of Project-related activities and would be treated as necessary to restore to pre-project conditions (final approval of treatment to pre-project conditions would be done by the Timber Sale Administrator *after* consultation with the district hydrologist and/or fisheries biologist). Implementation of the activity-specific BMP's (Appendix 1) would further ensure that hydrologic connectivity in streams and special aquatic features not be adversely affected by the action alternatives.

2.1.7. Alternatives Considered But Eliminated from Detailed Study

Federal agencies are required by NEPA to thoroughly explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not analyzed in detail (40 CFR 1502.14). Scoping comments received in response to the proposed action sent out on October 30, 2014, provided suggestions for alternative methods for achieving the purpose and need for the Project (see Alternatives A, B, C, D, and E). Based on NEPA case law, alternatives can be eliminated if the proposed alternative 1) does not achieve the purpose and need; 2) has substantially similar consequences as alternatives considered in detail; 3) is not significantly distinguishable from alternatives already being considered; 4) is infeasible; 5) is ineffective; 6) is inconsistent with basic policy objectives for the action; or 7) if the existing range of alternatives sets forth alternatives necessary to permit a reasoned choice (Schmidt 2009, Region 3 2009, BLM 2010).

Alternative A -An alternative was considered that would maximize harvest on slopes less than 35 percent throughout the Project area.

This alternative was considered to address the potential of recovering the maximum amount of wood fiber affected by the fire. Alternative A was the initial look at the Project area to determine if it was feasible to maximize the volume of fire-affected trees salvaged. In developing

alternative A, the IDT evaluated areas on slopes less than 35 percent, in compliance with the SNF LRMP, for their suitability for harvest and snag retention. Of the approximately 12,595 acres on slopes less than 35 percent, approximately 6,659 acres burned greater than 50 percent fire severity and were dominated by conifers. These 6,659 acres represent areas available for salvage of fire-affected trees or conversely for snag retention.

Alternative A would maximize salvage volume from available acres less than 35 percent slope and minimize snag retention on these same areas. The alternative would create an all or nothing approach by slope class. Basically, more of the remaining snags would be found on steeper slopes (greater than 35 percent) and few, if any snags, would be found on slopes less than 35 percent. Alternative A would meet the SNF LRMP S&G of 4 snags per acre (S&G 11) by essentially grouping snags on steeper slopes. This is in contrast to the proposed action that retains snags across the entire Project area including slopes less than 35 percent (lots of snags on steep slopes and scattered patches, clumps and single trees on gentle slopes). Alternative A would salvage fire-affected trees from most of the 12,595 acres available on slopes 35 percent or less as a first or secondary entry.

While operationally feasible, alternative A would ignore the benefits of snags to wildlife derived from maintaining snags across the Project area, the economic feasibility of harvests, road access, and heterogeneity of the landscape and therefore would not meet the purpose and needs of the Project (elimination criteria 1). The IDT examined the transportation system, wildlife habitat, burn severity, and access to slopes below 35 percent to develop alternative 2 (proposed action), rather than maximizing harvest in alternative A, meeting law, regulation, and policy (criteria 6).

Alternative B - An alternative was considered that would utilize cable or helicopter equipment.

This alternative was considered to address the concerns described by the public proposing the use of cable or helicopter equipment. Specifically, the comment requested consideration of helicopter harvest as part of the proposed action, to utilize cable to retrieve harvested logs or yard logs using a helicopter where in selected units retained in the environmental analysis of the Project if economic or operational constraints allow.

Alternative B would extend harvests on some steeper ground in the northern portion of the Project area and would extend harvest on gentle slopes with poor or no road access. Alternative B is similar to alternative A in that is seeks to maximize volume removal. An economic analysis was performed for the Project to study the potential financial effects of including helicopter units and volume in the proposed alternative. Actual units, logging plan, and data have not been generated for the proposed salvage timber sale. Approximately 600 (acres considered) acres of conifer-dominated forest types were available for helicopter harvest on slopes greater than 35 percent. In comparison, the proposed action would retain snags on the 600 acres on steep slopes within the proposed helicopter logging area. An examination of helicopter logging costs concluded that harvest on steep slopes using helicopters would result in a negative value; creating a situation where the rest of the Project would not be able to be complete, namely reforestation. The SNF performed a thumbnail appraisal to determine the economic feasibility of helicopter salvage. There are approximately 653 acres of high and moderate fire intensity areas on slopes greater than 35 percent within the entire Project area. Excluding habitat (2004 Framework S&G 14), the addition of 600 acres of helicopter salvage to the tractor salvage areas resulted in a timber sale deficit. (See the Economics Analysis for Helicopter Logging located in the Project record).

Positive economic value from tractor harvest on slopes less than 35 percent are needed to remove volume from the steeper areas, in order to complete the reforestation and other restoration

activities. As in alternative A, the alternative would reduce the economic return and remove snag retention areas without achieving either the economic efficient recovery of the timber value objective or the snag retention objective. This alternative was eliminated from further study because it does not meet the Project need for maintaining snags for wildlife habitat as described in the purpose and need section and restoration activities would be reduced for the purpose of maximizing volume through helicopter methods. Alternative B would harvest in areas of negative economic value for the sole purpose of using a particular method of harvest. Volume maximization alone is inconsistent with purpose and need objectives for economically efficient timber harvest, maintaining wildlife habitat, and providing funding for reforestation efforts (criteria 1). The 2004 Framework S&G 13 directs the Forest Service to design Project to minimize harvest costs when recovering the value of timber killed or severely injured by the disturbance. Helicopter salvage would be infeasible and therefore was not considered as an action in this Project (criteria 4).

Alternative C – An alternative for inclusion of underground storage tanks for drafting purpose.

This alternative was considered to address the recommendation described by the public to analyze one or more underground storage tanks with either gravity feed or a submersible pump (depending on site specific conditions) and have the development as part of the timber sale contract. The proposal for underground tanks was directed for dust abatement and road maintenance due to the shortage of water resources within the proposed Project boundary.

The IDT analyzed the Project transportation system and areas to determine locations of installing one or more underground tanks. Tank(s) would need to be located in strategic locations that would be accessible to large vehicles and equipment. After IDT input and consideration the line-officer determined that current sources of water were adequate for drafting and dust abatement for this Project. The IDT suggested this action be considered in the future as a separate project if drought continue.

Alternative C was eliminated from further study because it is not necessary to meet the purpose and need as the Project design already has a means in place to provide a water source for dust abatement.

Alternative D - Herbicide application method.

During scoping, a commenter suggested a specific method of herbicide application. Specifically, that the use of herbicides should be limited to the creation of heterogeneous fine-grained patches, variably sized and shaped within stand patches that are less than one quarter acre in size. The no action, analysis of no herbicide use, and the slight difference in herbicide application in alternative 2 to alternatives 4 and 5, demonstrate a wide range of herbicide use and analysis. The IDT discussed this application method and found that it is not significantly distinguishable from alternatives already being considered and within the existing range of alternatives sets forth alternatives necessary to permit a reasoned choice (criteria 3 and 7).

Alternative E –Site Preparation Technique

A follow-up site preparation treatment using a winged ripper to rip up bear clover rhizome root masses was considered but not examined in detail. Sierra Pacific Industries (SPI) has utilized ripping of bear clover on their lands. However, SPI usually applies an herbicide treatment prior to ripping. In addition, due to the ripping technique, SPI plants their trees in rows. Both hydrology and soils design criteria call for retention of at least 50 percent of the treatment area with intact

ground cover (includes undisturbed ash). For ripping to be an effective site preparation method, slash concentrations would need to be removed on more than 50 percent of the area in order for ripping to be accomplished. This would not meet the hydrology and soils design criteria; therefore a concern for the purpose and need (criteria 1 and 6). Between the design criteria of 50 percent or greater undisturbed ground cover and stumps that would need to be avoided, insufficient ground area would be free of bear clover.

2.1.8. Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. The alternatives can be compared in terms of (a) how well they respond to the purpose and need for action and (b) in terms of indicators identified by resource specialist. Table 9 and Table 10 below provide a comparison of the alternatives in these two regards. Information in the tables is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively between the alternatives. Detailed analyses for the indicators by resources are summarized in Table 10 are provided in Chapter 3 of this EA.

Table 9. Comparison of Alternatives by purpose and need.

Purpose and/Need/Issue to Address	**Alternative 1** (No Action)	**Alternative 2** (Proposed Action)	**Alternative 3** (No Herbicide)	**Alternative 4** (Hazard Tree & Plantation Salvage Only)	**Alternative 5** (No Secondary Entry)
1.1.3.1. Provide for Safety – Need to provide a safe forest transportation that is hazard free. **Source of Direction**: FSM 7733.04c, FSH7709.59 Ch. 40 & 41	Alternative 1 does not provide safe travel ways because it does not remove hazard trees along roads resulting in unsafe conditions	Alternative 2 removes hazards from roads in the Project area providing for public and worker safety	Same as alternative 2	Same as alternative 2	Same as alternative 2
1.1.3.2. Recover Economic Value of Fire-Affected Trees – Need to recover economic value of fire affected trees in a timely and cost efficient manner **Source of Direction**: LRMP as revised by 2004SNFPA ROD, p. 52	Alternative 1 would not generate revenue or volume, therefore the need of recovering economic value of burned timber for the benefit of local communities and forest management infrastructure would not be met	Alternative 2 would meet the need of recovering economic value generating $269,933 in revenue and 31.5 mbf in volume	Same as Alternative 2	Alternative 4 would meet the need of recovering economic value generating $96,466 of timber value and 10.0 mbf (21.5 mbf less than Alt. 2)	Alternative 5 would meet the need of recovering economic value generating $257,644 of timber value and 27.0 mbf (4.5 mbf less than Alt. 2)
1.1.3.6. Re-establish Forested Conditions - -Need to reestablish forested conditions in deforested areas. **Source of Direction**: NFMA; FSM 2471 and 2472	Alternative 1 would not reforest areas deforested by the fire, therefore the need to establish conifers, provide pine regeneration, and accelerate conifer growth to achieve "old forest conditions would not be met	Alternative 2 creates an environment suitable for establishment and growth of shade intolerant species such as pine and accelerate conifer growth, brush growth is maintained below 20% in reforested areas. Approximately 3000 acres are proposed to be planted.	Replanted conifer survival is lower and conifer growth is slower than alternative 2, brush is maintained above 20% in most reforestation areas. However, the number of replanted acres and release treatments is far more than alternative 2.	Same as alternative 2 methodology; however, the number of acres planted would decrease to 2400 acres, 600 less than alternative 2.	Same as alternative 2 methodology; however, the number of acres planted would decrease to 2900 acres, 100 less than alternative 2.
1.1.3.3. Manage fuel load levels Need to manage fuel loading within the Project area to achieve short-term and long-term desired	Alternative 1 would not remove fuels, therefore max. fuel loads would increase 508% to 686%tons/acre in 30	Alternative 2 would remove fuels from Project area, reducing fuel load to at least	Woody shrubs become established within the treated areas	Reduction in treated acres will reduce the amount of fuels reduction in the	Reduction in treated acres will reduce the amount of fuels reduction

conditions. **Source of Direction:**2004 SNFPA ROD, p. 52:	years	20 tons/acre in treatment areas after all treatment have been completed	reducing fire suppression effectiveness in longer term.	Project area.	in the Project area.
1.1.3.7. Manage Fuel Loadings within Defensive Fuel Profile Zones (DFPZ's) in Strategic Topographic Locations- Need to manage vegetation re-growth and fuel loading in identified DFPZ's to provide fire managers the needed anchor points and safe locations to engage future wildfires **Source of Direction:** 2004 SNFPA ROD, p. 52:	Alternative 1 would not remove fuels, therefore max. fuel loads would increase 508% to 686% tons/acre in 30 years	Alternative 2 would remove fuels from Project area, reducing fuel load to at least 20 tons/acre in areas after all treatments have been completed	Woody shrubs become established within the DFPZ areas reducing fire suppression effectiveness in longer term.	Reduction in treated acres will reduce the amount of fuels reduction in the project area.	Reduction in treated acres will reduce the amount of fuels reduction in the project area.
1.1.3.8. Reduce existing fuel load and salvage trees felled along Southern California Edison Company Stevenson 12 kilovolt (kV) distribution line right of way. Need to reduce fuel loading of felled trees underneath distribution line to prevent hazardous situation of suppression forces. **Source of Direction:**2004 SNFPA ROD, p. 52:	Alternative 1 would not remove fuels, leaving current fuel load of 100+ tons/acre	Alternative 2 would remove fuels from Project area, reducing fuel load to at least 20 tons/acre in areas after all treatments have been completed	Same as alternative 2	Same as alternative 2	Same as alternative 2
1.1.3.9. Eradicate Invasive Weeds to protect native vegetation and wildlife habitat - Need to eradicate invasive weeds; Issue with use of herbicides **Source of Direction : FSM 2903,** 2004 SNFPA ROD, p. 36, S&G 36 –49 p. 54	Alternative 1 would not eradicate invasive weeds, therefore medusahead, would expand in the Project area	Alternative 2 would use manual and chemical methods to eradicate invasive weeds, medusahead would be eradicated within 6 years of implementation; there would be low to negligible effects to humans and animals	Alternative 3 would use only manual and mechanical methods to control medusahead, eradication may not be possible without herbicides; there would be no effects to humans or animals from the use of herbicides	Same as alternative 2	Same as alternative 2

1.1.3.4. Provide Wildlife Habitat through Large Woody Debris and Snag Retention - Need to provide and maintain habitat for wildlife species (particularly fire associated species such as black-backed woodpecker) in the Project area **Source of Direction :** 2004 SNFPA ROD, p. 36, S&G 36 –49 p. 54	Alternative 1 would retain all snags and large woody debris, 3,617 acres of black-backed woodpecker habitat (habitat for 15.6 woodpecker pairs) would not be treated.	Alternative 2 would salvage burned trees, 1,946 acres of black-backed woodpecker habitat (habitat for 6.8 pairs) would be treated and 1,673 acres of habitat (habitat for 8.8 pairs) would not be treated.	Same as alternative 2	Alternative 4 would not salvage burned trees except in some plantations and roadside hazard trees, 796 acres of black-backed woodpecker habitat (habitat for 3.3 pairs) would be treated and 2,821 acres of habitat (habitat for 12.3 pairs) would not be treated.	Alternative 5 would salvage less burned trees compared to alt 2 and 3. Therefore, 1,716 acres of black-backed woodpecker habitat (habitat for 5.8 pairs) would be treated and 1,901 acres of habitat (habitat for 9.8 pairs)) would not be treated.
1.1.3.5. Reduce potential soil erosion and the loss of soil productivity caused by loss of vegetation and surface organic matter – Need to reduce soil erosion and loss of soil productivity. **Source of Direction :** 2004 SNFPA ROD, p. 36, S&G 36 –49 p. 54	Alternative 1 would not help reduce soil erosion and loss of soil productivity.	Alternative 2 would help reduce soil erosion and loss of soil productivity using BMPs	Same as alternative 2	Same as alternative 2	Same as alternative 2

Table 10. Comparison of Alternatives by resources analyzed in full

Resource	Indicator	**Alternative 1** (No Action)	**Alternative 2** (Proposed Action)	**Alternative 3** (No Herbicide)	**Alternative 4** (Hazard Tree and Plantation Salvage Only)	**Alternative 5** (No Second Entry)
Aquatic Resources	1). Sierra Nevada yellow-legged frog suitable habitat affected.	151 acres of SNYLF habitat (pre-fire) would not be treated.	41 acres (19 individual areas) of SNYLF habitat would receive road hazard treatment; 11 areas would receive vehicle use; 10 areas would receive road maintenance. Herbicide impacts are negligible due to design criteria designating a 25 foot buffer from suitable habitat.	Due to design criteria, alternative 3 would have the same as effects on aquatic resources as alternative 2, assuming hand grubbing is used to avoid a CWE response. Without that mitigation, aquatic resources would be impacted by the sedimentation into riparian habitat.	Same as alternative 2, except the herbicide buffer is designated as 500 feet from suitable habitat.	Same as alternative 2, except the herbicide buffer is designated as 500 feet from suitable habitat.
	2). Yosemite toad suitable habitat affected	36 acres of YT habitat (pre-fire) would not be treated.	Same as alternative 1.	Same as alternative 1.	Same as alternative 1.	Same as alternative 1.
	3). California red-legged frog suitable habitat affected.	20 acres of CRLF habitat (pre-fire) would not be treated.	4 acres (one individual area) of CRLF habitat would receive road hazard treatment and vehicle use; 2	Due to design criteria, alternative 3 would have the same as effects on aquatic	Same as alternative 2, including the herbicide buffer designated a 125 foot buffer from	Same as alternative 2, including the herbicide buffer designated a 125 foot buffer from

			acres (one individual area) of CRLF habitat would receive plantation treatment. Herbicide impacts are negligible due to design criteria designating a 125 foot buffer from suitable breeding habitat.	resources as alternative 2, assuming hand grubbing is used to avoid a CWE response. Without that mitigation, aquatic resources would be impacted by the sedimentation into riparian habitat.	suitable breeding habitat.	suitable breeding habitat.
	4). Foothill yellow-legged frog suitable habitat affected.	1,255 acres of FYLF habitat (pre-fire) would not be treated.	424 acres of potential habitat would receive a combination of roadside hazard, first and second entry, plantations, DFPZ, and power line clearing. Herbicide impacts are negligible due to design criteria designating a 325 foot buffer from suitable habitat and limited operating period (LOP) from October 1st to April 30th.	Due to design criteria, alternative 3 would have the same as effects on aquatic resources as alternative 2, assuming hand grubbing is used to avoid a CWE response. Without that mitigation, aquatic resources would be impacted by the sedimentation into riparian habitat.	Same as alternative 2 including herbicide affects, LOP, and buffer, except habitat would not receive first or second entry treatments.	Same as alternative 2 including herbicide affects, LOP, and buffer, except habitat would not receive second entry treatment.

	5).Western pond turtle suitable habitat affected.	2,520 acres of WPT habitat (pre-fire) would not be treated.	895 acres of potential habitat would receive a combination of roadside hazard, first and second entry, plantations, DFPZ, and power line clearing. Herbicide impacts are negligible due to design criteria designating a 325 foot buffer from suitable habitat and limited operating period (LOP) from October 1st to April 30th, below 5,000ft.	Due to design criteria, alternative 3 would have the same as effects on aquatic resources as alternative 2, assuming hand grubbing is used to avoid a CWE response. Without that mitigation, aquatic resources would be impacted by the sedimentation into riparian habitat.	Same as alternative 2, including herbicide affects, LOP, and buffer, except habitat would not receive first or second entry treatments.	Same as alternative 2, including herbicide affects, LOP, and buffer, except habitat would not receive second entry treatment.
Botanical Resources	Number of FS sensitive plant occurrences and their aerial extent (in square meters, miles of stream, or acres).	The number of occurrences would remain the same and the aerial extent of each occurrence would remain constant or increase; though there is a higher risk that medusahead would negatively affect habitat of lower elevation	The number of occurrences would remain the same and the aerial extent of each occurrence would remain constant or increase. Herbicide use would not impact FS sensitive plants due to Project design.	The number of occurrences would remain the same and the aerial extent of each occurrence would possibly decrease if invasive non-native weeds spread into FSS plant habitat. The risk is especially high that medusahead	Same as alternative 2.	Same as alternative 2.

		species like Madera leptosiphon.		would negatively affect habitat for *Madera leptosiphon*.		
	Number of invasive weed infestations and their aerial extent (in square meters or acres).	Medusahead would expand in the Project area (more infestations, larger number of acres)	Medusahead would potentially be eradicated within six years of implementation; other weeds would be promptly detected and eradicated.	Medusahead would be reduced in number of acres and infestations, but eradication may not be possible without herbicides. A timeframe for eradication is not estimated, as eradication without herbicide is not thought to be feasible.	Same as alternative 2	Same as alternative 2
Economics	1). Revenue of harvest volume; Purpose and need of recovering economic value of burned timber and forest products recovered in a cost efficient manner	Alternative 1 would not generated revenue or volume, the need for recovering economic value of burned timber for benefit of local communities and forest would not be met	Approximately 31.5 mbf, would be harvested, value would be approximately $269,000, meeting the need for recovering economic value of burned timber for benefit of local communities and forest	Same as alternative 2	Approximately 10 mbf, would be harvested, value would be approximately $96,466. This is approximately 21.5 mbf and $173,467 of timber value less than alternative 2.	Approximately 27 mbf, would be harvested, value would be approximately $230,585. This is approximately 4.5 million mbf and $39,348 of timber value less than alternative 2.
	2). Cost of other recovery and reforestation work;	Taxpayers would save	Alternative 2 would cost	Alternative 3 would cost	Alternative 4 would cost	Alternative 5 would cost

	The purpose and need of cost effective treatments that benefit local communities and forest management	approximately $4,772,246of appropriated funds needed to implement these activities	approximately $4,772,246. Taxpayers would spend approximately $4,770,000 of appropriated funds needed to implement these activities	approximately $10,245,514, which is more than alternative 2 by approximately $5,203,335. Taxpayers would spend approximately $9,975,581 of appropriated funds needed to implement these activities	approximately $3,770,106, which is less than alternative 2 by $1,098,607. Taxpayers would spend approximately $789,605 of appropriated funds to implement these activities.	approximately $4,803,957, which is less than alternative 2 by $5,441,557. Taxpayers would spend approximately $4,570,000 of appropriated funds to implement these activities.
	3). Employment benefit (socioeconomics); The purpose and need of recovery of timber value and forest products – benefit to local communities and forest management	Would provide limit employment benefit, creates 4.2 full time job with financial benefits of $345,000.	Would create 413 direct and indirect full time jobs and 151 fulltime jobs for other recovery and reforestation work. Total of 564 fulltime jobs with income of $22.5 million.	Would create 413 direct and indirect full time jobs and 426 fulltime jobs for other recovery and reforestation work. Total of 839 fulltime jobs with income of $33.5 million, increase of $10.9 million than alternative 2.	Would create 131 direct and indirect full time jobs and 95 fulltime jobs for other recovery and reforestation work. Total of 276 fulltime jobs with income of $9.0 million, decrease of $24.5 million than alternative 2.	Would create 413 direct and indirect full time jobs and 416 fulltime jobs for other recovery and reforestation work. Total of 829 fulltime jobs with income of $33.2 million, increase of $365,324 million than alternative 2.
Forest Health/Vegetation	Changes in Forest Structure	CWHR types would shift to montane chaparral types in lower elevations and to	Alternative 2 treatments would reduce snag habitat and early successional brush CWHR habitat,	Alternative 3 treatments would reduce snag habitat and early successional brush habitat,	Alternative 4 treatments would reduce snag habitat and early successional brush habitat	Alternative 5 treatments would reduce snag habitat and early successional brush habitat

		white fir or fir-dominated mixed conifer in higher elevations; snag habitat would be maintained	increase dominance of pines and increase growth of conifer dominated CWHR types.	increase dominance of pines; and due to the lack of herbicide treatment bear clover/and brush competition with planted trees seedlings would substantially reduce seedling survival and growth rates of conifer dominated CWHR types. Both growth rates and seedling survival would be 65 to 75% less than alternative 2.	within roadside hazard areas and plantations, increase dominance of pines and increase growth of conifer dominated CWHR types	within roadside hazard areas, first entry areas and plantations, increase dominance of pines and increase growth of conifer dominated CWHR types.
	Number of Trees per Acre (Moderate and high fire severity areas)	10 to 50 at age 20	125 to 200 at age 20 (Untreated areas 10 to 50)	Additional replanting replanting and release treatments would be necessary to achieve these numbers, 50 to 100 at age 20. (Untreated areas 10 to 50)	125 to 200 at age 2 (Untreated areas 10 to 50)	125 to 200 at age 20 (Untreated areas 10 to 50)
	Hazard Tree Removal	No hazard trees would be	Removes hazard trees on 2353 acres	Removes hazard trees on 2353	Removes hazard trees on 3513	Removes hazard trees on 2773

		removed.	plus those within first and secondary entry areas and plantations	acres plus those within first and secondary entry areas and plantations	acres plus those within plantations	acres plus those in first entry areas and plantations
	Conifer reforestation, bear clover, and brush	Very slow conifer establishment. .High and moderate fire severity areas dominated by bear clover and brush. 10 to 50 one to four ft. tall conifers per acre at age 20 At age 50, conifers 1 to 3 inches dbh, 5 to 12 ft. tall. At age 70, conifers 2 to 6 inches dbh, 7 to 15 ft. tall. Natural regeneration dominated with shade tolerant incense cedar and white fir	3,000 acres reforested. 125 to 200 six to 7.5" dbh, 20 to 26 ft.tall conifers per acre at age 20. Concentrates reforestation on highest fire severity areas At age 50, conifers 9 to 11 inches dbh, 55 to 75 ft. tall At age 70, conifers 20 to 23inches dbh, 75 to 100 ft. tall. Plantations dominated by shade intolerant ponderosa pine and rust resistant sugar pine High and moderate fire severity areas not treated dominated by bear clover and brush	3,000 acres planted. 50 to 100 one to 2" dbh, 5 to 6 ft. tall conifers per acre at age 20. Concentrates reforestation on highest fire severity areas At age 50, conifers 2 to 3 inches dbh, 8 to 11 ft. tall. At age 70, conifers 6 to 8 inches dbh, 20 to 30 ft. tall. Plantations vegetated with shade intolerant ponderosa pine and rust resistant sugar pine with substantial bear clover competition. High and moderate fire severity areas not	2,400 acres reforested. 125 to 200 six to 7.5" dbh, 20 to 26 ft.tall conifers per acre at age 20. Does not reforest 1697 acres of highest severity fire areas reforested under alt. 2 At age 50, conifers 9 to 11 inches dbh, 55 to At age 70, conifers 20 to 23inches dbh, 75 to 100 ft. tall. 75 ft. tall Plantations dominated by shade intolerant ponderosa pine and rust resistant sugar pine High and moderate fire severity areas not treated	2,900 acres reforested. 125 to 200 six to 7.5" dbh, 20 to 26 ft.tall conifers per acre at age 20. Does not reforest 490 acres of highest severity fire areas reforested under alt. 2. At age 50, conifers 9 to 11 inches dbh, 55 to 75 ft. tall At age 70, conifers 20 to 23inches dbh, 75 to 100 ft. tall. Plantations dominated by shade intolerant ponderosa pine and rust resistant sugar pine High and moderate fire severity areas not treated

				treated dominated by bear clover and brush	dominated by bear clover and brush	dominated by bear clover and brush
Fire and Fuels	1). Fuel loading – Weight of the combustible material available to burn, expressed in tons per acre.	Moderate to high severity areas-fuel loading is predicted to increase to over 180 tons/acre over baseline conditions in 50 years. Low to mod. severity area -- Fuel loading is predicted to increase to over 200 tons/acre in 50 years. Maximum fuel loading in all classes within mod. to high and low to mod. will increase 508% - 686% over baseline conditions in 50 year	Moderate to high severity areas-fuel loading is expected to be reduced by an average of 36%-45% over 50 years. Low to moderate severity areas - fuel loading is expected to be reduced by an average of 47%-48% over 50 years. The conifer reforested areas would remain vulnerable to high tree mortality from fires (wildfire) until they reach ages greater than 20 years (McGinnis 2010). Fire suppression effectiveness increases in treated areas and resistance to control lowers. Roads and DFPZ's would provide for safe ingress and	Similar to alternative 2, the difference in not using herbicides will mean that fuels (brush and grass) would be expected to dominate planting areas, increasing ladder fuels in reforested areas. The conifer reforested areas would remain vulnerable to high tree mortality from fires (wildfire) until they reach ages greater than 20 years (McGinnis 2010). Due to the increased competition that would reduce growth of these trees from the FM 2 bear clover, the time to reach a	Same as alternative 2 in areas of treated acres. The difference in acres from alternative 2 would be the same as the no action.	Same as alternative 2 in areas of treated acres. The difference in acres from alternative 2 would be the same as the no action.

			egress for fire resources and to utilize for fire control lines. They would be easier for holding operations with future fuels management prescribed burning, managed wildfires' and indirect fire suppression strategies. Aerial delivered water/fire retardant would be more effective.	safe size for fire survival would increase to 70 yrs. Fire suppression effectiveness is limited in treated areas and resistance to control increases. The DFPZ treatment areas would be less effective at providing an anchor point for fire management in the long term.		
	2). Flame length – The average length of a flame at a given point used as an observable measure of fire line intensity. Expressed in feet.	Fuel models 8, 9 & 11- Would remain below baseline flame length conditions of 0-8 ft Fuel models 2, 5& 10 – Flame lengths would range from 25%-125% above the baseline condition. Of 0-8 feet.	Fuel models 8, 9 & 11- Would meet baseline flame length conditions of 0-8 ft. Fuel models 2, 5& 10 – Flame lengths would range from 31%-78% above the baseline condition of 0-8 feet. Ground forces would be able to construct fireline faster through these types of grass	Fuel models 8, 9 & 11- Would meet baseline flame length conditions of 0-8 ft. Fuel models 2, 5& 10 – Flame lengths would range from 31%-78% above the baseline condition of 0-8 feet. The fuel bed (FM 2 bear clover) in these areas would	Same as alternative 2 in areas of treated acres. The difference in acres from alternative 2 would be the same as the no action.	Same as alternative 2 in areas of treated acres. The difference in acres from alternative 2 would be the same as the no action.

			fuels as compared to the other alternatives.	not support fire suppression effectiveness due to the very slow fireline production rates and high fireline intensity that bear clover produces when it burns. Aerial delivered retardant/water supporting ground forces is effective at slowing fires in these fuels but this advantage is lost if crews cannot construct line fast enough.		
Herbicide Use	Effects on humans	No effects	The Project risk assessment indicates that effects on human health and safety would be low to negligible following the Project's design criteria and manufacturer's instructions.	Same as alternative 1, as no herbicides would be used in this alternative.	Same as alternative 2.	Same as alternative 2.
	Effects on animals	No effects	Low to negligible, as per specialists'	Same as alternative 1, as	Same as alternative 2,	Same as alternative 2,

			analysis (3.2.2. Herbicides), SERA (2011) and project level risk assessment worksheets. Specific to alternative 2, a 25 foot buffer is applied to waterways above 5000feet elevation for SNYLF and YT	no herbicides would be used in this alternative.	except there is an additional 475 foot no herbicide buffer (total of 500ft) on perennial streams over 5,000ft elevation for SNYLF & YT.	except there is an additional 475 foot no herbicide buffer (total of 500ft) on perennial streams over 5,000ft elevation for SNYLF & YT.
Terrestrial Wildlife	1).California spotted owl suitable habitat; Components of CSO habitat that have been modified destroyed or fragmented.	9,484 acres of owl habitat (pre-fire) would not be treated	1,929 acres would be treated under low/moderate mortality categories, 2,524 acres would be treated under the high mortality category. There is negligible risk to terrestrial wildlife when glyphosate is applied at the recommended rate. Our analyses indicate that with the reforestation proposed under Alternative 2, the canopy cover would respond	Similar to alternative 2, except without herbicide and habitat recovery could be delayed significantly due to the competition from bear clover and manzanita on planted pines and cedar within the reforestation areas. Within 50 years, conifer establishment under this alternative is projected to be equivalent to	1,590 acres would be treated under the low/moderate mortality categories, 1,488 acres would be treated under high mortality category. Herbicide treatments have the same negligible risk as alternative 2.	1,754 acres would be treated under the low/moderate mortality categories, 2,309 acres would be treated under high mortality category. Herbicide treatments have the same negligible risk as alternative 2.

			back to pre-fire condition within a 30 year period. Within 50 years, the reforested areas are projected to be CWHR 4D (12-15" dbh and canopy cover 60-100%) which is suitable owl nesting habitat.	CWHR size class 2 (sapling, 1-6 inches dbh) and canopy closure S (10-24% canopy cover) which is not suitable spotted owl nesting habitat.		
	2). Pacific fisher suitable habitat; Components of fisher habitat that have been modified destroyed or fragmented	9.934 acres of fisher habitat (pre-fire) would not be treated	2,062 acres would be treated under low/moderate mortality categories, 2,639 acres would be treated under high mortality category. There is negligible risk to terrestrial wildlife when glyphosate is applied at the recommended rate.. Our analyses indicate that with the reforestation proposed under Alternative 2, the canopy cover would respond back to pre-fire condition within a	Similar to alternative 2, except without herbicide and habitat recovery could be delayed significantly due to the competition from bear clover and manzanita on planted pines and cedar within the reforestation areas. Within 50 years, conifer establishment under this alternative is projected to be equivalent to CWHR size class 2 (sapling, 1-6	1,711 acres would be treated under the low/moderate mortality categories, 1,570 acres would be treated under the high mortality category. Herbicide treatments have the same negligible risk as alternative 2. Less of the key linkage area "D" between fisher core populations 4 and 5 would be treated and reforested under this alternative,	1,882 acres would be treated under the low/moderate mortality categories, 2,418 acres would be treated under the high mortality category. Herbicide treatments have the same negligible risk as alternative 2.

			30 year period. Within 50 years, the reforested areas are projected to be CWHR 4D (12-15" dbh and canopy cover 60-100%) which is suitable fisher denning habitat.	inches dbh) and canopy closure S (10-24% canopy cover) which is not suitable fisher denning habitat and does not promote the fisher corridor connectivity.	which could lead to a more fragmented population.	
	3). Black-backed woodpecker habitat; Components of BBWO habitat that have been modified destroyed or fragmented	3,617 acres of BBWO habitat (post-fire) would not be treated	1,946 acres of habitat would be treated under high/moderate mortality category. There is negligible risk to terrestrial wildlife when glyphosate is applied at the recommended rate.	Same as alternative 2, except without herbicide.	1,150 fewer acres would be treated under this alternative. Herbicide treatments have the same negligible risk as alternative 2.	230 fewer acres would be treated under this alternative. Herbicide treatments have the same negligible risk as alternative 2.
Watershed – Hydrology	1). Water quality; (temperature/sediment/chemical) Potential for increased runoff, erosion, sediment yield, turbidity & increasing water temperature.	Increased hillslope and bank erosion has the potential to decrease water quality in the short term. Water quality from post fire hydrological response would attenuate with time, returning to a state of	Temperature -No changes is expected to cause stream temperatures to change, due to no harvesting in SMZs Sediment – Effect is expected to be small, short term (1-3 years) increases in sediment to streams is expected	Temperature same as Alternative 2 and chemicals will not be used. Using mechanical means to control bear clover for reforestation (e.g., blading or tilling) would require the clearing (by dozer piling) each area	Same as alternative 2.	Same as alternative 2.

		equilibrium in the long term	to be non measureable. Chemicals not expected to have negative effects on water quality when mitigated with BMPs.	of downed woody material to allow for effective mechanical release. The loss of ground cover and disruption of the soil structure over 2300 acres would exacerbate CWE conditions, potentially leading to accelerated erosion and sediment delivery to streams; hand grubbing would be the only way to mitigate a CWE response.		
	2). Flows and channel stability; Channel response to increase flow and sensitivity to disturbance from Project implementation	Increased water yield and peak flows have the potential of increased bank erosion rates in the short term. Long term vegetation recovery is expected (5 to 10 year) to help channel stability	Project is not expected to affect channel stability and minimized through design criteria and BMPs.	Same as alternative 2.	Same as alternative 2.	Same as alternative 2.

3.0. Chapter 3 - Environmental Impacts of the Proposed Action and Alternatives

This section focuses on the affected environment and environmental effects for those resources that the Project intends to improve from the existing conditions (needs for the Project) and those resources related to key issues identified during scoping as well as resource issues and concerns identified internally. Additional resource areas are addressed because they were a concern or recommendation during internal and public scoping (but not an issue), or an analysis was required by law. These resource areas are briefly summarized following this introduction because they have no effects due to Project design.

This section summarizes the physical, biological, social and economic environments of the affected Project area and the potential changes to those environments due to implementation of the alternatives. It also presents the scientific and analytical basis for comparison of alternatives presented in section 2.0. Some resource sections discuss some of the same topics and may seem repetitive; however, certain topics (e.g. fire severity, basal area, herbicide use) apply to multiple resources and are analyzed as to how they relate to that specific resource. Methodology and assumptions used for the analyses are described in the specialist reports for each resource located in the Project record.

This section includes discussions of direct, indirect, and cumulative effects. Direct environmental effects are those occurring at the same time and place as the initial cause or action. Indirect effects are those that occur later in time or are spatially removed from the activity, but would occur in the foreseeable future. Cumulative effects result when the incremental effects of actions are added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. Cumulative effects can result from individually minor, but collectively substantial, actions taking place over a period of time. In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior actions and natural events, including the French Fire, that have affected the environment and might contribute to cumulative effects. A list of existing and reasonably foreseeable projects considered in determining cumulative effects for various resources is included in Appendix E.

3.1. Scope of Analysis

This EA focuses on potential effects to several resource areas responding to the issues and concerns raised during internal agency and public scoping and the purpose and need for the Project (see section 1.6 and section 1.1). The EA analyzes resources that may be perceived as being sizably affected by the Project and demonstrates the SNF's compliance with environmental regulations including the SNF LRMP. These sections include: safety, forest health and vegetation, economics, fire and fuels, terrestrial wildlife, management indicator species (MIS) – black-backed woodpecker, soils and water resources, herbicide use, and botanical resources and invasive weeds. Reports with detailed analysis for each of these resources (BA/BEs, MIS, specialist's reports, etc.) are located in the Project Record, summarized in each section of this chapter and are hereby incorporated by reference.

Other resource areas are sometimes also included in EAs. No key issues were raised related to these resource areas, however there may have been concerns raised during internal and public scoping or an analysis is required by law. It was determined through the individual resource analyses and reporting that there would be no major effects from the Project to air quality, climate change, cultural resources, recreation (dispersed and developed), soils, and visual resources (scenery). These reports are located in the Project record and are hereby incorporated by reference.

3.1.1. Air Quality

Annual emissions from smoke produced from prescribed burning from this Project are estimated to create up to 25 tons of Particle Matter at 10 microns (PM_{10}), 24 tons of Particle Matter 2.5 microns ($PM_{2.5}$), and 17 tons Nitrogen Oxides (NO_2). Emissions produced would be below the threshold of San Joaquin Valley's acceptable *de minimus* of 100 tons per year.

Annual trends in ozone and PM air pollution are decreasing largely due to State regulations for vehicle emissions. This is expected to continue as technology and regulations to reduce emissions are implemented. In addition, mechanical treatments (harvesting) contribution to air pollution in particular appears to be on a downward trend likely due to decreased logging activity. The incremental effects of this Project when added to past, present and foreseeable future activities, are not likely to influence this trend of reduced logging associated emissions.

Emission from exhaust hydrocarbons and Visible Dust Emissions (VDE) PM_{10} from logging and mechanical activities would be below *de minimus* based on emissions modeling procedures and anticipated harvest volume. The emissions produced from harvesting equipment from this Project would be considered regionally insignificant (total emissions are less than 10 percent) of the area's total emissions inventory is estimated at 0.3 tons for $PM_{2.5}$, 10 tons for PM_{10}, and 5 tons for Nitrous Oxide (NO_X). The Project is above 3,000 feet in elevation and is exempt from Regulation VIII, Rule 8011 General Rule Requirement, though dust abatement is still required by the Forest Service and lowers the fugitive VDE from to 3.7 pounds per year which is below *de minus* of 10 tons per year.

Though the Project does meet the General Conformity Rule of the Clean Air Act for all Project activities, it would not interfere with the strategies employed to attain National Ambient Air Quality Standards (NAAQS). Conformity would be accomplished through a multi-year implementation plan of the Project and by maintaining burn ignitions and acres within rules and guidelines developed by the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) and the Unified Guidelines for Smoke Management developed by the Southern Sierra Interagency Smoke Management Group. These guidelines and rules are based upon the requirements found in the State Implementation Plan (SIP) and standards of California Air Pollution Board (CARB). The Project is determined to be in compliance with SIP standards, General Conformity Rule, and Title 17 of the California Code of Regulations. It is important when considering the determination that compliance with SIP is based upon meeting rules and guidelines managed by SJVUAPCD. These rules and guidelines are designed to meet historical emissions levels and keep projects from violating the SIP. The alternatives propose activities that would meet the rules and guidelines. Rules and guidelines along with daily SJVUAPCD direction control acres and ignitions. Meeting the acres and ignition rules and guidelines meets conformity with the SIP emission standards.

3.1.2. Climate Change

Climate influences the processes of growth and disturbance in which the historic forest developed (Keeley and Stephenson 2000). While climate cannot be influenced by a single project or landscape scale manipulation, it can and has changed over the last 4,000 years. Climate trends for the SNF indicate increasing temperatures with increasing precipitation over the past 100 years (Meyer, Safford, and Sawyer 2012); however, this trend in temperature and precipitation is not consistently observed across the Southern Sierra Nevada. A detailed description of climate change prepared by Meyer, Safford, and Sawyer (2012) across the SNF is hereby incorporated by reference. This past climate may not represent future climate changes. Current temperatures are rising within a short-term cycle (100 years) while temperatures are declining on a longer cycle (1,000 years) (Millar and Woolfenden 1999). It is unclear what the future will mean for climate change.

Wildfire and extensive forest mortality as a result of insect and disease are primary sources of unintentional carbon emissions from forests in the Western United States (Stephens 2005).

Current science indicates that the total area of high severity burned forest in the Sierra Nevada is not lower than historic reference conditions (Safford 2010, Mallek et al. 2013) and the size of high severity burned patches has substantially increased (Miller and Safford 2008, and Miller *et al.* 2009, Miller and Safford 2012). Lutz et al. (2009) found in a study conducted in Yosemite National Park that the proportion of area burned at higher severities increased with annual area burned. Recent findings in northwest California (Miller et al. 2012) differ from results for the Sierra Nevada and adjacent southern Cascades, where an increasing trend in the percentage of high severity fire for ponderosa pine and mixed conifer forest types has been reported (Miller et al. 2009a).

Forests play a major role in the carbon cycle. The carbon stored in live biomass, dead plant material, and soil represents the balance between CO_2 absorbed from the atmosphere and its release through respiration, decomposition, and burning. Over longer time periods, indeed as long as forests exist, they will continue to absorb carbon. Complete, quantifiable information about Project effects on global climate change is not currently possible and is not essential to a reasoned choice among alternatives. However, based on climate change science, we can recognize the relative effects of these treatments on the ecosystem carbon cycle.

The combination of a warmer climate with carbon dioxide fertilization may cause more frequent and more severe fire is the western United States (Miller et al. 2009; Westerling et al. 2006; Meyer, Safford, and Sawyer 2012 and Stephens et al. 2009). Models suggest that the length of the fire season, as expressed by a measure of temperature, drought indices, degree days and fire weather indices will be longer (McKenzie et al. 2004). Ryan and others state that this is already happening as a result of past fire suppression, as high-intensity fires occur in ecosystems that are adapted to low-severity fire regimes. The largest risk to carbon storage is that the forest may not regenerate, losing much carbon in the process (Ryan et al. 2010). Therefore the potential indirect effects of taking no action are that wildfires have the potential to be larger and more severe, which volatilizes more carbon into the atmosphere.

3.1.3. Cultural Resources

A cultural resource report was completed for this Project which documents the identification and management of historic properties in the Project area, in accordance with the 2013 Programmatic Agreement Among the USDA Forest Service, Pacific Southwest Region (Region 5) California State Historic Preservation Officer, Nevada State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Processes for Compliance with Section 106 of the National Historic Preservation Act for Management of Historic Properties by the National Forests of the Pacific Southwest Region (Regional PA). The report, French Fire Recovery and Reforestation Project, R2015051551003 (Potter 2015), is incorporated by reference and enclosed in the final Project record. The report describes cultural resource inventories within the Project area and provides records of 145 archaeological and historic sites in the French Fire boundary, and 12 other sites near the Project area. Because the report contains information on the nature and location of archaeological and cultural resources, it will be kept administratively confidential per 36 CFR 296.18

No adverse effects to cultural resources are anticipated from implementation of the action alternatives. Specific protection and management measures derived from the Regional PA would be applied to cultural resources as design criteria (see section 2.1.6.4.). The protection and management measures are described in detail on a site-specific basis in the cultural resource report (Potter, 2015). All National Register of Historic Places-eligible and potentially eligible properties would be managed for no adverse effect (per the Regional PA) from Project activities.

3.1.4. Recreation (Dispersed and Developed)

The Forest Service operates Mile High Vista, Fish Creek Campground and Rock Creek Campground under California Land Management (CLM) concessionaire as well as maintains the Shakeflat Trailhead in the Project area. High use season for these facilities is May through September with activities that would include camping, sightseeing, hiking, hunting and firewood cutting/collecting. There are no designated OHV routes within the Project area. Authorized OHV use would be done on designated roads. Maintained roads within the Project area

for public use are analyzed in the transportation analysis. No additional recreation related work is being proposed outside the scope of hazard tree removal within the Project boundary.

Under Alternative 1, no action would be taken to address the purpose and need of the Project. Short term and potentially long term disturbance to the recreational resources is highly anticipated. Burned and dying hazard trees would continue to exist in the Project area. Dead trees will create a risk to the health and safety of forest visitors and Forest Service employees causing extended closures of sites. Long term closure of recreation sites in the Project area would directly and indirectly negatively impact recreation access and experience of the areas classified Recreation Opportunity Spectrum (ROS) compatibility as a Roaded Natural setting. Compromised long-term user safety is a primary reason for greater potential impacts with the no action alternative, since hazard trees would not be removed and could lead to additional recreation related cumulative effects in the future, by increasing deferred maintenance costs of facilities and trails.

Alternatives 2 through 5 are expected to have long term positive impacts from hazard tree removal and road maintenance to recreation resources within the Project area. Rock Creek and Fish Creek Campgrounds, as well as Mile High Vista and Shake Flat Trailheads, would have minimal effects because there are design criteria put in place that would minimize Project activities during the peak season months of recreational use. There are no expected direct effects from salvage treatments because there are no planned salvage treatments within the developed recreation sites. There is potential for short term indirect effects to recreation in developed and dispersed areas caused by traffic and noise generated by logging trucks associated with roadside hazard tree removal. However, Project activities would be minimized during the recreational peak season by limiting operations on weekends and, therefore effects would be minimal. Long term indirect and cumulative effects to recreation access, experience and ROS compatibility would not be expected if any action alternatives were chosen and implemented. There would be an overall positive effect to the safety and access of dispersed and developed recreation areas with the mitigation of the roadside hazard tree removals.

3.1.5. Soils

Indicators including soil stability, surface organic matter, soil organic matter, soil strength, and soil structure and macro-porosity were used to determine if project implementation would have adverse effects on the soil's support for plant growth, hydrologic, and filtering & buffering function. In areas planned for ground based operations (i.e. skidding, tractor piling, masticating and/or grapple piling) a minimum of 50% ground cover will be maintained to prevent accelerated erosion. On slopes greater than 35%, soil cover will be maintained at 70%. Past observations on the SNF in other timber operations have found this amount of soil cover generally prevents accelerated erosion from occurring. Ground based operations generate excess material adding to those areas currently deficient, ground cover within the high and moderate soil burn severity is expected to increase. Salvage logging immediately increases the biomass of woody debris on the ground (Monsanto et al., 2008). If sufficient ground cover is not maintained accelerated erosion will occur leading to a decrease in both soil productivity and water quality. Minimal tractor piling and grapple piling in these areas, while still maintaining fuels objectives, will maximize the amount of material available for soil cover further increasing soil stability. The most effective way to minimize the amount of surface runoff and sediment production post-fire is to increase the amount of surface cover (Larsen et al., 2009). Additional ground cover can be expected once vegetation re-establishes itself in the burn area, one to three years post-fire. A solid conclusion is that surface organic cover comprises the first line of defense against the erosion of surface soil (Powers, 2002).

Ground operations are expected to generate excess woody debris and in those areas where the surface organic matter has been consumed, this additional material aids in developing a new surface organic matter horizon. The re-establishment of the surface organic layer will take years to decades to return to its previous state, depending on the amount of consumption that has taken place and the influx of available material. The removal of the surface organic matter is not expected to decrease the productivity of the areas proposed for reforestation within the Project area. Removing all surface organic matter prior to planting had no general impact on total vegetative production after 10 years (Powers et al., 2005). Under severe burning conditions, soil organic matter can be removed or destructively altered, nutrients volatilized, water-absorbing capacity decreased, and living

plant parts and microorganisms killed (Brown et al., 2003). Soil inputs following disturbance depend less on decomposition of surface residues and more on the decay of fine roots that remained from the previously harvested stand (Powers et al., 2005). Soil organic matter has accumulated over long time periods, decades to centuries, from root turnover and the biomass of soil organisms. In the most heavily impacted areas it can be expected the soil organic matter will take considerable time before it returns to natural conditions. However, the soil organic matter wasn't extensively altered by the fire and a loss of soil productivity isn't expected, fine roots where charred but still present only near the surface horizon.

During times of increased soil moisture, increased soil disturbance will occur during skidding operations with a rubber tired skidder. This type of equipment generates more pressure on the soil below, increasing the amount of soil disturbance (soil compaction), as the piece of equipment travels back and forth repeatedly on the same piece of ground. Whereas, a grapple piler or masticator, which is a tracked piece of equipment, generates less ground pressure, resulting in less soil disturbance. Soils need soil moisture content below 14-16% to minimize detrimental soil disturbance and/or compaction within fine textured soils. Due to the forest floor consumption, especially within the high and moderate soil burn severity, additional impacts from ground based operations would occur during periods of increased soil moisture. Fire removes the protective organic layer and exposes the soil to disturbance and compaction from ground-based logging equipment (Peterson et al., 2009). Unless logging occurs when soils are dry or mitigation measures are applied, this can exacerbate erosion (Peterson et al., 2009). Compaction is a great concern in soils with a fine soil texture such as the Holland soil family and less of a concern in coarser soils such as the Chaix and Umpa soil families. Tree growth tended to be reduced by compaction on clayey soils and increased on sandy soils (Powers et al., 2005). To the extent possible, subsequent harvests using heavy skidding equipment should rely on existing disturbance pathways, allowing for recovery and subsequent productivity enhancement between entries (Moghaddas et al., 2008). Areas located on steep 25%-35% slopes where skidding may be adverse (uphill skidding) increased ground disturbance, deeper ruts and potential topsoil removal, will occur. Short sections of steep slopes for ingress and egress of a treatment unit may have to be crossed with logging equipment and some soil disturbance is expected to occur.

Creation of any additional landings, temporary roads and skid trails need appropriate erosion control measures to minimize the occurrence of accelerated erosion. Forest roads, whether built to facilitate post-fire logging or not, can exacerbate hydrologic effects by concentrating and channelizing surface and subsurface flow (Peterson et al., 2009). An increased amount of surface runoff is expected throughout the fire area so appropriate erosion control measures are crucial. Ground based operations would likely break up the thin layer of soil sealing and the soil hydrophobic layers, increasing soil infiltration rates and decreasing the amount of runoff and sediment generated in these areas.

Minimal leaching of Glyphosate is expected to occur below the six to twelve inch boundary in the soil profile. Soils with somewhat excessively drained and excessively drained drainage classifications have the highest potential for off-site movement. Utilizing buffer zones around drainages will allow for minimal effects to adjacent streams. Glyphosate's ability to bind itself to the soil particle, the ability of soil particles suspended in runoff with Glyphosate residues attached reaching surface waters is mitigated by the Project's design criteria. No cumulative effects related to repeated applications of herbicides to forest soils are known for Glyphosate (Busse et al. 2001 & Ratcliff et al. 2006). Based on best available science and the implementation of the Project's design criteria, the herbicide impact to soils will be inconsequential.

With implementation of Project design criteria and BMPs, no adverse effects to the soil's support for plant growth, hydrologic, and filtering & buffering function will occur. Additional post-fire analysis of fire effects on soil productivity can be found within the French Fire BAER Soil Report (Takenaka, 2014).

3.1.6. Visual Resource (Scenery)

The majority of the Project area is within the retention and partial retention Forest Plan visual quality objectives (VQOs). The retention VQO provides for management activities which are not visually evident to the casual Forest visitor; whereas the partial retention VQO provides for management activities that remain subordinate to

the surrounding natural landscape (USDA-FS 1974). There are minor slivers of modification VQO within the Project area, but no treatments are being proposed within this VQO. The Project area also lies within the Scenic Corridors Recreation Setting. The Sierra Vista Scenic Byway is one of two scenic corridors on the Forest that connects diverse visitors of all skill levels to a wide range of recreation opportunities from viewing outstanding scenery at numerous vistas to camping, hiking, picnicking, and rafting (USDA-FS 2007). In addition to the Sierra Vista Scenic Byway, the Mammoth Pool Road, French Trail, and recreation sites (i.e., Fish Creek Campground, Rock Creek Campground, Shakeflat Trailhead, and Mile High Vista) are highly used travelways and use areas within the Project area from where the public views the landscape and are expected to have high concerns for scenic quality.

Prior to the fire, the dominant scenery attributes that were prominent in the landscape and essential to the valued image within the Project area were the vegetation scenery attributes (i.e. large trees [>18" dbh, diverse tree species and size classes, and the mosaic vegetative patterns from a continuous forested-canopy to an understory that consisted of patches and clumps of diverse shrubs and ground covers]). The mosaic burn pattern of the French Fire created vegetation patches that ranged from full consumption of timber and vegetation to very low or unburned (Fire and Fuels Report 2015), and eliminated several of these large trees and diverse vegetation scenery attributes. The other dominant scenery attributes within or near the Project area such as Mammoth Pool Reservoir and Balloon Dome and the minor scenery attributes that contribute to the valued image of the landscape but are less noticeable such as creeks, rock outcroppings, and landform are not nearly as critical as its vegetation, since these scenery attributes change relatively little over time, regardless of fire behavior and human activities.

The travelways and use areas (i.e. Sierra Vista Scenic Byway, Mammoth Pool Road, French Trail, Fish Creek Campground, Rock Creek Campground, Shakeflat Trailhead, and Mile High Vista) are the units of spatial analysis (points of reference) from where the effects on scenery are analyzed.

Under alternative 1, there would be no direct effects to scenery as no Project activities would be proposed, but there would be potential indirect adverse effects. There would be increasing levels of fuel loading from fire and bug killed trees over the extent of the Project area (Fire and Fuels Report 2015). In addition, herbaceous and shrub species such as bear clover would also begin to take over the burned areas and compete with the re-establishment of trees. For example, it is likely to have a 75% reduction in ponderosa pine tree growth with bear clover competition (Silviculture Report 2015). In 50 years, with little bear clover, ponderosa pine trees would grow 12 to 15 inches dbh and 55 to 70 feet tall. In the same 50 years, with bear clover competition, ponderosa pine would only grow 4 to 5 inches dbh and 15 to 17 feet tall (Silviculture Report 2015). The fire-killed trees would remain and be a hazardous wildfire fuels concentration which would threaten the adjacent scenic, forested-canopies. Disturbances such as wildland fire that result in extensive areas of dead or dying trees are perceived as having a negative impact on visual beauty (Ryan 2005). Due to these conditions, Alternative 1 would increase the intensity and likelihood of future wildfire and delay the re-establishment of the large trees and diverse vegetation scenery attributes in the fire-killed patches.

Under Alternative 2, the proposed activities would have short-term direct effects and positive direct and indirect effects to scenery. The proposed fuel treatments would reduce levels of fuel loading from fire and bug killed trees over the extent of the Project area, which would help remove downed wood and prevent further dead tree conditions. Removing dead wood, piles, and slash can greatly increase scenic ratings (Ryan, 2005). The proposed invasive weed treatments would reduce shrubs such as bear clover from competing with the reforestation treatments. The proposed salvage harvest treatments (first and second entry) would remove the hazard trees and dying trees and help with the reforestation treatments. The short-term direct effects caused by visible disturbances such as burn piles, landings, and temporary roads would be minimized with the implementation of design criteria. Alternative 2 would reduce risks for potential large and high intensity wildfires and their subsequent adverse effects to scenery and expedite the re-establishment of large trees and diverse vegetation scenery attributes.

Under Alternatives 3 through 5, there would be short-term and positive direct effects within the treated areas similar to Alternative 2, except that there would be a range of potential indirect adverse effects to scenery. Alternative 3 would have potential indirect adverse effects due to the non-use of herbicides that may increase fuel loading and shrub cover that would compete with the reforestation treatments. Subsequently, the reforestation treatments would take longer to establish and reach desired forested conditions. Alternative 4 would have greater potential indirect adverse effects compared to Alternatives 3 and 5 because only hazard tree and plantation salvage treatments would be proposed. The areas that would not be treated in Alternative 4 would be similar to Alternative 1. Alternative 5 would have greater potential indirect adverse effects compared to Alternatives 2 and 3 because there would not be a second entry salvage harvest treatment. However, Alternative 5 would have less potential indirect adverse effects compared to Alternative 4 as there would be more treated areas in Alternative 5 that would include salvage harvest and reforestation treatments that would help with the re-establishment of the large trees and diverse vegetation scenery attributes. The areas that would not be treated in Alternative 5 would be similar to Alternative 1.

The existing burned Project area does not comply with the retention and partial retention Forest Plan VQOs, but would gradually evolve to meet these VQOs, depending on which action alternative is selected, as vegetation establishes over time and then slowly becomes re-occupied by a dominant forest-canopy across much of the Project area. Alternative 2 would be the most beneficial for scenery to expedite the re-establishment of the desired forest conditions and large trees and diverse vegetation scenery attributes, followed by Alternative 3, Alternative 5, and lastly Alternative 4. Until then, the Project area would meet the Maximum Modification VQO, a two or three level decrease from the Forest Plan VQOs of retention and partial retention.

3.2. Aquatic Wildlife

The information presented in this section and in subsequent sections is summarized from the French Recovery and Restoration BE BA and Invasive weed Assessment (March 2015), which is hereby incorporated by reference.

3.2.1. Background and Affected Environment

The aquatic species analysis addresses the effectiveness of the alternatives in meeting the purpose and need to protect sensitive species and to protect and enhance their potential and suitable habitat within the Project area. The aquatic also addresses concerns and recommendations raised during scoping related to the analysis Endangered Species Act-listed Sierra Nevada yellow-legged frog (endangered) and Yosemite toad (threatened). A Biological Evaluation and Biological Assessment (BE/BA) (Wilkens 2015) have been completed for this Project, and are hereby incorporated by reference.

Affected Environment

The French burn area intersects three 6th-Field HUC 12 watersheds (Refer to Aquatic BE/BA), and several major perennial drainages (Refer to Aquatic BE/BA). The aquatic analysis area used for this assessment was delineated by 23 sub-drainages that intersected the Project treatment boundary (Refer to Aquatic BE/BA). The sub-drainage aquatic analysis area incorporates all stream channels, water and its associated riparian corridors, which represent the majority of potential habitat for fish and herpetofauna. Cumulative effects and evaluation of habitat connectivity is also facilitated by use of the sub-drainage analysis area.

Seasonal (stream order 1-3) and perennial (stream order 4+) miles are associated with the project by sub-drainage. Based upon the SNF GIS layers with field verification on primary stream channels in the treatment portions of the project area, the analysis area contains approximately 360 miles of ephemeral channels, 166 miles intermittent streams, and 50 miles of perennial streams.

There are also approximately 8 lakes/ponds and one reservoir within the aquatic analysis area. Perennial streams and lakes are potentially habitat for amphibians, reptiles (herpetofauna), and fish. The primary creek drainages within the aquatic analysis area are Chiquito, Shakeflat, Rock, and Fish Creeks, all of which flow into the San Joaquin River and/or Mammoth Pools reservoir. Mammoth Pools and the San Joaquin River are part of hydroelectric facilities operated by Southern California Edison.

Aquatic species discussed in this analysis are associated with meadow and perennial habitat. According to the corporate GIS meadow layer with overlay of new meadow perimeters using the 2012 NAIP imagery, there are approximately 112 meadows for a total of about 144 acres within the 23 subdrainages of the aquatic analysis area of the Project (Refer to Aquatic BE/BA).

The aquatic analysis area is within the Sacramento-San Joaquin zoogeographic province as described by Moyle (2002). Moyle identifies much of the west slope of the Sierra Nevada mountain range above 5,000 feet in elevation as being historically fishless due to glaciation during the Pleistocene and steep topography. The fish community represented within the aquatic analysis area is characterized by three main assemblages. Fish assemblages for the San Joaquin River drainage in the lower reaches include deep-bodied fishes (below 91 meters elevation). In Sierra Nevada foothill streams, Pikeminnow-hardhead-sucker assemblage occupies a narrow altitude range (27-450 meters elevation). Habitats are characterized as high water quality with deep, rocky pools and wide, shallow riffles (Moyle 2002). Stream meanders and riparian vegetation create complex habitats. Summer water temperatures may exceed 25º C with some waters becoming intermittent in the summer. The rainbow trout assemblage for the zoogeographic province described by Moyle (2002) is located in areas of larger and colder streams. Habitats are characterized as having more riffle than pools, with water temperatures seldom exceeding 21ºC. Resident trout are considered self-sustaining within the drainage basin where they are located.

Historical surveys within the aquatic analysis area have identified that “trout” occur over approximately 23 miles in major perennial tributaries (Rock Creek=6 miles; Fish Creek=5 miles; Shakeflat Creek=4 miles; Slide Creek=1 mile; Chiquito Creek=3 miles; West Fork Chiquito Creek= 4 miles . These species are collectively referred to as resident trout. A put-and-take fishery is maintained by the California Department of Fish and Game along in Shaver Lake. Within the aquatic analysis area along Minarets Road, several areas such as Fish and Rock Creeks are popular areas for camping and angling and are subject to angling pressure where fish are present.

Data Summaries

Information contained in this report represents a compilation of stream condition and species observation in stream and meadow habitats. Segments of aquatic analysis area streams have been surveyed for stream channel characteristics and stability between 1977 and 2004. Channels and riparian areas were evaluated using various methodologies, including Rosgen channel typing, Pfankuch channel stability ratings, and Channel Analysis. Historical conditions of the aquatic environment were evaluated considering a combination of the data collected during these surveys. Of the stream data collected for the project area, most information dates from the early to mid 1990s. Surveys for herpetofauna (amphibians and aquatic/riparian reptiles) were completed at various times; however, herptofauna surveys were not conducted post-fire, thus areas of potential habitat were considered occupied for the purposes of this analysis.

Species surveys have been conducted on portions of several stream channels within aquatic analysis sub-drainages that may have suitable habitat for listed species between 1990 and 2013 prior to the French Fire. Surveys were conducted by USFS crews. These surveys include aquatic species VIS surveys as describe in Fellers and Freel (1995), Sierra Nevada yellow-legged frog species surveys, Yosemite Toad surveys, Step II Channel Analysis Biological Observations, general amphibian surveys (1995), and incidental reports. However, herptofauna surveys were not conducted post-fire, thus areas of potential habitat were considered occupied for the purposes of this analysis.

3.2.1.1. Indicators

Measured Indicators

Indicators are measures that can be used to describe the condition of aquatic/riparian ecosystems. They represent elements that might change as a result of management activities. Changes may alter the quantity and quality of habitat available. Although there have been no riparian indicators identified in a Landscape Analysis for the project area, canopy cover and water temperature are considered as indicators that could potentially be affected by the types of activities being proposed. Baseline indicator data was not able to be collected prior to the French Fire for the project area. Since the French Fire has contributed to the primary changes in the landscape condition, including reducing canopy cover and potential changes to water temperatures, evaluation indicators were not selected for this Project. Additional effects from the proposed treatments to the reduction in canopy cover and potential subsequent stream temperature increase could not be teased out from the fire effects. Treatments will follow BMPs, project design criteria, and are anticipated to reduce potential sediment run off and increase ground cover in areas of high severity burns.

Analysis Methodology

The following lists assumptions that are specific to aquatic/riparian wildlife and habitat:

1. Project design criteria are implemented and LRMP and ROD standards and guidelines are followed.
2. When implemented, LRMP and ROD standards and guidelines, along with Best Management Practices will maintain or improve riparian conditions, reduce effects of Project activities, and protect aquatic/riparian system habitats.
3. Evaluation of species effects were reviewed for consistency with the LRMP, and incorporated best relevant science which included but was not limited to peer-reviewed literature, Forest survey information, material presented by researchers, and personal communications.
4. BMP monitoring would provide a basis for evaluating success of project design criteria in maintaining or improving aquatic/riparian habitat.
5. The direct and indirect effects consider the time element covered by the proposal.
6. Initial set up of project actions followed the Streamside Management Zones (SMZ's) and Riparian Management Zones (RMA's) no mechanical buffer distances. For aquatic features:
    a. Springs, lakes, and meadows on the SNF corporate GIS coverage's are correct. Project-level analysis (field verification) on streams that may be considered perennial streams improved the accuracy of this assumption.
    b. Project-level analysis field verification on streams improved the accuracy of the layer.
    c. For streams RCA widths not field verified, RCA widths are considered as:
        i. Order 2 and 3 streams = Seasonal (150 feet)
        ii. Order 4 + streams = Perennial (300 feet)
        iii. Meadows, Springs, and Lakes = Perennial (300 feet)
7. Aquatic/riparian species in this analysis area can occupy perennial water type habitats. Perennial streams were verified in the project area.
8. Appropriate species habitat and dispersal corridors from the California Wildlife Habitat Relationship program (CDFG 2005) were updated to reflect USFWS dispersal distances (USDI-FWS 2013a, 2013b) for TEPCS species potential suitable habitat.

The Project was reviewed on the ground and using aerial photographs, species specific spatial datasets and known information to help determine the potential presence of FSS species. For the analysis of effects, potential affects to suitable habitat were determined using a spatial dataset of potential habitat overlaid with treatment types (e.g., Roadside Hazard Tree Removal). Potential habitat was not surveyed for the presence of TES species, and was therefore assumed to be occupied.

3.2.2. Environmental Consequences

This section analyzes the effects from the Project and alternatives on the aquatic/riparian threatened, endangered, proposed, candidate and sensitive species and their habitats. Effects of the action refers to the direct, indirect, and cumulative effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action.

Most amphibians depend on both aquatic and terrestrial habitats to complete their lifecycle. Beyond the stream channel, the riparian and upland habitats provide important habitat for species that depend on mesic ecotones to forage, aestivate, and reproduce (Burke and Gibbons 1995; Castelle and others 1994; Semlitsch 1998 in Elliot et.al 2010). Species diversity and abundance of amphibians and reptiles may be dramatic in riparian systems where it provides habitat for 83% of the amphibian and 40% of the reptile species (Brode and Bury 1984). Recent recognition that stream-breeding amphibians can disperse hundreds of meters into uplands implies that connectivity among neighboring drainages may be important to their population structures and dynamics (Olson et al. 2007). Maintaining the linkages between aquatic and terrestrial habitats is critical for supporting sustainable populations.

When areas outside riparian corridors are disturbed, riparian buffers filter some impacts; however stream and riparian habitat conditions can become degraded in the short or long term. As riparian areas become unable to filter properly, sedimentation in streams results in a reduction in interstitial spaces that can affect reproductive success in amphibian populations, depress growth rates from lost foraging space, and expose individuals to increased predation (Perkins et al. 2006). In most small streams and rivers, the seasonal pattern of water temperature is determined largely by the extent that direct solar radiation and air temperature can modify the temperature of the water. Loss of shade from streamside forests can greatly warm streams, increase aquatic species demand for dissolved oxygen and reduce the amount of dissolved oxygen available it the water.

Management activities have the potential to alter conditions along terrestrial and aquatic system migratory corridors where amphibians and reptiles live, breed and forage. The fragmentation of native riparian cover types influences the distribution of certain wildlife species, often favoring opportunistic species over those with more specific habitat requirements (Knopf and others 1988; Raedeke 1988 in Elliot et.al 2010). In some regions, breaks in riparian corridor continuity can impact animal movement (Smith 2000 in Elliot et.al 2010). Narrow corridors that are essentially edge habitat may encourage generalist species, nest parasites, and predators (Knopf 1986; Knopf and others 1988 in Elliot et.al 2010).

Timber management: Riparian areas are vulnerable to both compaction and physical disturbance during ground harvesting operations due to areas of high moisture and low soil strength that are common within streamside zones (Dwire et al. 2010). Activities such as felling a tree may cause minimal soil disturbance, however, movement of logs of whole trees to a landing or collection point may disturb the soil surface.

Mechanical chipping and mastication operations are being widely prescribed to treat hazardous fuel, yet the implications of these practices on riparian and watershed conditions are largely unknown (Dwire et al. 2010). As compared to typical harvesting operations and unharvested stands, these fuel management prescriptions rearrange the amount, size, and orientation of surface woody materials (Dwire et al. 2010). Similar to other upland management activities, these mechanical treatments are likely to influence soil processes and nutrient retention within riparian areas. A recent review of published findings relating to woody debris additions reported that implementation of chipping and mastication treatments varies considerably among sites depending on equipment and operational differences (Resh et al. 2006). Soil carbon and moisture increased following the mechanical fuel reduction operations. Maximum soil temperature and understory vegetation declined. Woody debris additions had variable effects on soil nutrients. In some cases, soil nitrogen availability decreased as carbon rich woody material stimulated microbial nitrogen immobilization (Binkley and others 2003; Blumfield and Xu 2003; Lalande et al. 1998 in Dwire et al. 2010). The potential for upland chipping or mastication to substantially alter nutrient and sediment movement into riparian areas partly depends on the horizontal continuity and depth of woody material additions. To date, there are no completed studies that directly assess the linkages between these new mechanical fuel management strategies and riparian processes or watershed conditions. (Dwire et al. 2010)

Fire and Fuels Reduction: While working to restore "healthy" forests and reduce the risk of catastrophic fires, forest managers must confront the challenge of maintaining biodiversity in western forests and incorporating the understanding of how fire affects semi-aquatic biota with the effects of fuel reduction management on wildlife in western forests (Bury 2004; Olson and others 2002 in Elliot et al. 2010). Management implications for forest lands adjacent to aquatic systems include effects on terrestrial and semi-aquatic species whose habitat requirements extend beyond the margins of wetlands, streams, and rivers (Houlahan and Findlay 2003; Semlitsch and Bodie 2003; Thompson and others 2003 in Elliot et al. 2010). Interactions between land management and climate change may be changing fire behavior and characteristics from what populations have recently experienced and potentially adapted to, including less frequent but more severe wildfire in dry forests or more frequent wildfire in forests that rarely burned historically (Hossack and Pilliod 2011).

The timing of fuel treatments (salvage and fuel reduction via jackpot and pile burning)may be of critical importance to the maintenance of overwintering habitats, post-emergence dispersal, and reproduction of amphibian and reptile populations (Thompson and others 2003). The coincidence of fire and migration, reproduction, and larval periods may determine the vulnerability of amphibian and reptile populations to wildfire. The vulnerability of amphibian populations to wildfire varies by region, species' life histories, and fire regimes. Studies suggest that direct fire related mortality of adult amphibians is rare, either because of the timing of the fire or because amphibian species were able to exploit refugia from fire (for example, burrows, moist ground, ponds, streams; (see papers summarized in Pilliod and others 2003 in Elliot et al. 2010). On the contrary, prescribed fire may increase the mortality of terrestrial amphibians by fire because prescribed burning usually occurs in fall to spring when amphibians in the Northwest are active (Bury 2004). Pilliod et al. (2003) identify that amphibians may be directly affected by fire (mortality), and indirectly through alteration of habitat.

Herbicides: Management of vegetation with chemical herbicides and pesticides can have major impacts on amphibian or reptile communities. In particular, several features of amphibian biology may enhance their susceptibility to chemical contamination (Stebbins and Cohen 1995). The life history of most amphibians involves both aquatic larvae and terrestrial adults, allowing exposure to toxicants in both habitats. Many amphibians have skin with vascularization in the epidermis and little keritinization, allowing easy absorption of many toxicants. In fact, many studies have demonstrated the effects of chemical contamination on amphibians (Hall and Henry 1992; Boyer and Grue 1995; Carey and Bryant 1995). The effects range from direct mortality to sub-lethal effects such as depressed disease resistance, inhibition of growth and development, decreased reproductive ability, inhibition of predator avoidance behaviors, and morphological abnormalities. Little has been studied on the effects of herbicides for reptile species, specifically turtles. In a few pesticide studies, Organochlorine pesticide residues on WPT eggs in an Oregon study were found to be low, but contained mercury and chromium, metals of special concern. Snapping turtle eggs near the Great Lakes-St Lawrence River basin reported evidence of effects on sex differentiation and reproductive endocrine function (Henny et al. 2003). Pesticides having the highest absorption into eggs tended to have both low sorption to organic carbon or lipids, and high water solubility, however confirmatory studies were identified as needed to elucidate pesticide absorption into turtle eggs and the potential risk they may pose to embryonic development (de Solla and Martin 2011).

Glyphosate is suggested to be a highly effective herbicide with a relatively short environmental persistence time (Giesy et al. 2000 in Ralyea 2005). The term relative is utilized by the authors as a means of comparison of effects between plants and animals. As explained by Solomon and Thompson, glyphosate is relatively nontoxic to animals but is an effective herbicide in plants because glyphosate inhibits the essential enzyme in the pathway to the synthesis of aromatic amino acids in plants; many animals obtain their aromatic amino acids from plants and other sources and do not possess this pathway of synthesis (2003). Glyphosate dissolves easily in water, with a low potential for leaching (USDA-FS 1997). Glyphosate does not bioaccumulate, biomagnify, or persist in a biologically available form in the environment. Its mechanism of action is specific to plants and it is relatively nontoxic to animals (Solomon and Thompson 2003). The main break-down product of glyphosate in soil is AMPA (aminomethylphosphonic acid), which is broken down further by soil microorganisms (USDA-FS 1997). Glyphosate remains unchanged in the soil for varying lengths of time, depending on soil texture and organic matter content. The half-life of glyphosate in soil can range from 3 to 249 days (USDA-FS 1997) and the typical half-life for glyphosate can range from 20 to 60 days (SERA 2003). Monitoring found neither

glyphosate nor AMPA were susceptible to leaching after a forest application in British Columbia (USDA-FS 1997).

Glyphosate is absorbed by soils and subjected to microbial breakdown. As a result, it is widely accepted that soil rapidly removes the herbicide from aquatic environments and any lethal impacts are restricted to a relatively brief window of time (Giesy et al. 2000, Thompson et al. 2003, Relyea 2005). Death of amphibians would occur before the breakdown of the herbicide could take place. The impact of soil on amphibian survival with glyphosate has not been reported.

Less is known about the environmental fate and toxicology of the surfactants commonly used in formulation with glyphosate. Testing of R-11 has been limited because none is required by EPA and the Department of Pesticide Regulation only requires testing on fish and insects. The adjuvant R-11 is a nonylphenol ethoxylate that is acutely toxic to aquatic life, and is suspected to be an endocrine-disrupting chemical (Bakke 2001, Stark and Walthall 2003 in BLM 2007). R-11, the surfactant that would be used with glyphosate, is labeled for application to water and has a history of satisfactory use in aquatic situations by California agencies such as the Dept. of Water Resources and the Dept. of Boating and Waterways. As a commercial product, glyphosate may be formulated with surfactants such as R-11 that increased efficacy but, in some cases, are more toxic to aquatic organisms than the parent material (Relyea 2005). The results of a Dept. of Fish and Game study show R-11 residues when applied aerially were 100 times less than would be necessary to produce acute mortality (Trumbo 2005). R-11 would be classified as Moderately Toxic to fish and Slightly Toxic to invertebrates (USDA-FS 2000).

Consequently, glyphosate based herbicide usage may pose risks for amphibian biodiversity in a variety of habitats if applied within species riparian corridors or directly to water. Many amphibians and reptiles spend a large fraction of their life in the terrestrial stage. Herbicides such as glyphosate are widely applied to terrestrial environments (Relyea 2005). Amphibian larvae may be particularly vulnerable to chemical exposure during metamorphosis. Xenobiotic chemicals may mimic hormones or interfere with radical cellular rearrangements that take place during metamorphosis (Hayes et al. 2002 in Cauble and Wagner 2004). In one study, with a no-spray streamside zone, very low concentrations were sometimes found in water and sediment after the first heavy rain (USDA-FS 1997). Information about impacts of glyphosate based herbicide use on reptiles, including turtles, is unknown.

Direct, Indirect, and Cumulative Effects

Direct effects are caused by the proposed activity and are immediate in nature (e.g. killing or injuring animals during project activities, loss of habitat, harassment, disrupted reproduction, noise disturbance). Indirect effects are caused by the proposed activity but are later in time or farther removed in distance, but are reasonably certain to occur (e.g. crushing rodent burrows, sediment into stream channels, fragmentation of habitat, loss of shelter cover or forage, and decrease in canopy cover). Interrelated actions are those that are part of a larger action and depend on the larger action for their justification (i.e. this action would not occur “but for” a larger action. Interdependent actions are those that have no considerable independent utility apart from the action that is under considerations (i.e. other actions would not occur ‘but for” this action). A cumulative effect is the effect on the environment that results from the incremental effect of the action when added to the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes the other actions and regardless of land ownership on which the other actions occur. Reasonably foreseeable future actions include those that are in any stage of project planning and those for which decisions have been made and are awaiting implementation. Cumulative effects are usually stated in terms of spatial (e.g. grazing, mining, and the proposed activity overlap in the same area of habitat) and temporal effects (e.g. changes in habitat over time from the past to the present to the future with and without the proposed activity).

Within the Project aquatic analysis area, it was determined there is potential habitat, that is assumed to be occupied due to lack of surveys, for SNYLF, YT, CLRF, FYLF, and WPT.

Sierra Nevada yellow-legged frog: The lakes and meadows present in the analysis area are small and poorly connected to streams, if at all. Connectivity of habitat for the species is intact only along two perennial stream

systems (Rock Creek and Fish Creek). However, Rock and Fish Creeks extend above 5,000 feet elevation, increasing the potential suitability of habitat for SNYLF. Western pond turtles are known to occupy streams in the Project area, suggesting stream velocity may be low enough, and pools deep enough, to support SNYLF.

Western pond turtle: WPT were detected during pre-fire surveys in the aquatic analysis and Project areas in numerous perennial stream channels (West Fork Chiquito, Chiquito, Shakeflat, Rock, and Ross Creeks). The presence of WPT suggests stream velocity may be low enough, and pools deep enough, to support other herpetofauna with similar habitat requirements, such as SNYLF, CLRF, and FYLF.

Yosemite toad: All habitat for Yosemite toad is upslope of the Project area, and the 36 acres located within the Project area represent less than 1% of the total 4,050 acres present in the analysis area. However, Project and analysis area habitat is contiguous with habitat at higher elevations.

California red-legged frog: Connectivity of habitat for the species is poor, with habitat present only on Chiquito and West Fork Chiquito Creeks (Strand 2008). However, CLRF can disperse several kilometers and could potentially access these habitats. Western pond turtles are known to occupy streams in the Project area, suggesting stream velocity may be low enough, and pools deep enough, to support CRLF.

Foothill yellow-legged frog: The species has not been detected in the analysis area or Project area prior to the fire. However, FYLF are co-located with WPT in Jose Creek, which is approximately five miles downstream. Western pond turtles are known to occupy streams in the Project area, suggesting stream velocity may be low enough, and pools deep enough, to support FYLF.

3.2.3. Alternative 1 (No Action)

Direct Effects

Proposed treatments would not occur within the French Project area under this alternative; therefore there would be no direct effects such as killing, injuring, crushing or disturbance to TES aquatic species. There would be no direct effects on TES aquatic species or their habitat as a result of the selection of Alternative 1 (No Action).

Indirect Effects

There would be no indirect effects to TES aquatic species or their habitat as a result of the selection of Alternative 1 (No Action). Proposed treatments would not occur in or near terrestrial or aquatic habitat where TES species may reproduce, live, travel thorough, or overwinter. No changes to terrestrial or aquatic habitats such as crushing of rodent burrows from equipment, compaction of soils, reduction in canopy cover, potential increase in stream temperature, or sediment into streams from soil disturbances will occur. No new roads, temp roads or skid trail would be created in or near potential or occupied habitat. No project piles would be created and burned. Overall, no short or long term improvements to habitats in the French Project area would occur.

Cumulative Effects

A list and general description of past, present and reasonably foreseeable projects within the aquatic analysis area is shown in Appendix E from the Aquatic BE/BA. The geographical scale for the aquatic analysis area includes sub-drainages that overlap the fire boundary. Projects that have occurred within 10 years are part of the current condition and watershed condition changes over the past 30 years. The project scale is based on aquatic species dispersal into overwintering stream habitats, dispersal corridors into adjacent habitats, and dispersal into terrestrial habitats for breeding or overwintering. The temporal scale is based on analyzing past, present and reasonably foreseeable activities not part of the existing conditions; also based on showing trends in stream habitat (i.e.: stream shade, water temperature) and habitat conditions of the watershed.

A wide range of activities have occurred and continue to occur across the landscape, which in combination represent the potential to cumulatively effect individuals or habitat for aquatic/riparian species. These activities

may occur across elevation ranges within the aquatic analysis area, thus could affect aquatic/riparian habitat in a similar manner and are presented as common to all species.

Activities in the analysis include transportation management; vegetation management; recreation and facilities; fire (wildfire); range (grazing); and climate change. Potential effects attributed to the activity from literature are described; however it does not imply that effects described are presently taking place. The Forest Service applies measures to reduce the probability of these effects. Measures include incorporation of Forest standards and guidelines (USDA-FS 1991); Best Management Practices (BMPs) (USDA-FS 2011); site specific design criteria; and the development of Project design features to reduce effects from an action. Each project is also evaluated for consistency with Riparian Conversation Objectives (USDA-FS 2001; 2004). Cumulative effects on physical aquatic habitat from the listed activities have been evaluated under a Cumulative Watershed Effects Analysis (Stone 2015).

Transportation Management (Roads):

Roads can affect habitat for aquatic/riparian species, result in direct mortality, serve as linear barriers to movement; modify animal behavior; alter the physical and chemical environments; serve as a conduit for non-native species; or fragment species habitat (Trombulak and Frissell 2000). Increasing road densities have been identified as contributing to declines of some species and aquatic habitat quality. Accelerated erosion results from new construction (Reid and Dunne 1984). Road excavation can disrupt sub-surface water transport, bringing water to the surface where flow is concentrated and velocities are much higher. Roads can also collect water and serve as an extension of the stream network, thus altering runoff and peak flows. Road crossings can serve as migration barrier to movement of aquatic species (Furniss et al. 1991) and serve as sites to introduce sediment or pollutants.

Slow moving species (such as reptiles and amphibians) are more susceptible to road mortality because their life histories often involve migration between wetland and upland habitats (Trombulak and Frissell 2000). Collisions with vehicles have been documented in numerous different aquatic and riparian dependent species and they may even be particularly vulnerable to it (Trombulak and Frissell *ibid*). Literature suggests that highest road-kill rates are near wetlands and that amphibians represent the largest percent of species. The SNF completed a Travel Management Plan (USDA –FS 2010) that eliminated cross-country travel, designated routes, and established a season of use for all roads. This helps reduce potential for current direct or indirect effects to dispersing amphibians.

Vegetation management*:* Riparian areas are vulnerable to both compaction and physical disturbance during ground harvesting operations due to areas of high moisture and low soil strength that are common within streamside zones (Dwire et al. 2010). Activities such as felling a tree may cause minimal soil disturbance, however, movement of logs of whole trees to a landing or collection point may disturb the soil surface.

Mechanical chipping and mastication operations are being widely prescribed to treat hazardous fuel, yet the implications of these practices on riparian and watershed conditions are largely unknown (Dwire et al. 2010). As compared to typical harvesting operations and unharvested stands, these fuel management prescriptions rearrange the amount, size, and orientation of surface woody materials (Dwire et al. 2010). Similar to other upland management activities, these mechanical treatments are likely to influence soil processes and nutrient retention within riparian areas. A recent review of published findings relating to woody debris additions reported that implementation of chipping and mastication treatments varies considerably among sites depending on equipment and operational differences (Resh et al. 2006). Soil carbon and moisture increased following the mechanical fuel reduction operations. Maximum soil temperature and understory vegetation declined. Woody debris additions had variable effects on soil nutrients. In some cases, soil nitrogen availability decreased as carbon rich woody material stimulated microbial nitrogen immobilization (Binkley and others 2003; Blumfield and Xu 2003; Lalande et al. 1998 in Dwire et al. 2010).

The potential for upland chipping or mastication to substantially alter nutrient and sediment movement into riparian areas partly depends on the horizontal continuity and depth of woody material additions. To date, there

are no completed studies that directly assess the linkages between these new mechanical fuel management strategies and riparian processes or watershed conditions (Dwire et al. 2010).

The Mile High Hazard Removal sale is currently underway in the Project area, which is removing <250 acres of hazard trees within 300' of Minarets Road (FS 81)(Appendix F). Additionally, a post-fire timber sale has been underway since 2013 in the 22,350-acre Aspen Fire, adjacent to the French Fire, on the east side of the San Joaquin River.

Hazard removal incorporates cutting and/or removal of damaged, rotten, and dead trees to abate roadside hazards within 300 feet of a road. When hazard trees are located near a special aquatic feature or TES occupied habitat, specific design criteria are applied (eg: drop and leave) to minimize impacts to TES habitat and species.

Stream flow may increase as basal area (and evapotranspiration) declines and peak flows can be indirectly affected by vegetation removal (Chamberlin et al.1991; Kattlemann 1996). Troendle (2001) indicated increased water yields following timber harvest, although treatments were primarily clearcuts rather than thinning, which most current and planned projects implement. In snow-dominated areas, nearly all of the change in flows would occur during spring runoff and spring runoff may occur slightly sooner if reductions in canopy allow faster melting of the snowpack. Such changes could affect habitat for aquatic riparian species.

Although these activities overlap with aquatic habitat, individual timber/vegetation removal Project have prescribed SMZ's which implement a no mechanical equipment buffer from upland activities, and provide some protection to aquatic systems and riparian habitat along streams, lakes and meadows. Under the SNFPA (USDA-FS 2001; 2004) a Riparian Objective Consistency Analysis is prepared to evaluate whether Project design features provide adequate protection of aquatic/riparian habitats and species viability. Other applicable measures for species and habitat projection include implementation of BMPs (USDA-FS 2000) as part of the Project design. Application of SMZ's, RMA's and implementation of BMP's developed for the project reduces the risk of soil compaction, or project associated erosion being transported to stream channels.

Additional protection measures or changes in Project activities to reduce impacts add additional protection to stream and riparian habitats associated with TES species.

Recreation and Facilities:

Recreation activities with potential affects to fish, amphibians and habitat include (but are not limited to) hiking, camping, picnicking, fishing, fitness exercise, motorized recreation, swimming, snow activities, horse use, scenery viewing, tourism, etc. (e.g. Fish Creek and Rock Creek Campgrounds, Shake Flat and Logan Meadow Trailheads). Recreation projects mostly consist of the rehabilitation of current facilities to update them to current universal accessibility standards. Some recreation projects include reconstruction or reroute of existing motorized or non-motorized trails.

Recreation activities have the potential to affect aquatic/riparian habitat through changes in hydrologic regime; site compaction; sediment contribution; loss of vegetation; reductions in species density; or direct mortality (Bury et al. 1977). Amphibians and reptile species adjacent to campgrounds may be subject to handling; collection; consumption; or translocation (Maxwell and Hokit 1999). Handling may harm animals or in some instances handlers. Increased mortality rates may result from pets accompanying recreationists, along with increases in predators (ravens, skunks, raccoons, coyotes or foxes) seeking refuse associated with recreational sites. Recreationists may unwittingly transport viruses, pathogens, non-native species or other pests through their movements, resulting in impacts to native biota. Ravens are noted as natural predators for a variety of herpetofauna (Kagrise-Sherman and Morton 1993; Jennings and Hayes 1994; Ashton et al. 1997; Maxell and Hokit 1999; and Boatman 2002). Ashton et al. (1997) notes that areas of human influence can drive out larger predators. Thus, the numbers of small predators (such as ravens) may be supported at artificially high numbers near areas of increased human activities. Recreational activities listed above will continue throughout the Project and aquatics analysis and are anticipated to contribute to cumulative effects. There are no planned, foreseeable, future projects within the aquatic analysis area that overlap SNYLF, YT, CRLF, WPT or FYLF habitats.

Wildfire (underburning, suppression and rehabilitation): The recorded fire history dating back to 1911 shows approximately 19 fires occurred in the aquatic analysis area, with approximately 14 of those occurring within the Project area.

Wildfires influence aquatic ecosystems both directly and indirectly. Direct effects include heating or abrupt changes in water chemistry (Minshall et al. 1989; McMahon and de Calesta 1990). Indirect effects include changes in hydrologic regime, erosion, debris flows, woody debris loading and riparian cover (Brown 1989; Megahan 1991). Riparian areas differ from upland areas in topography, microclimate, geomorphology and vegetation. Further they are characterized as having cooler air temperatures, lower daily maximum air temperatures and higher relative humidity. These characteristics may contribute to higher moisture content of live and dead fuels and riparian soils, which presumably lowers the intensity, severity and frequency of fire (Dwire and Kauffman 2003). The ecological diversity of riparian corridors is maintained by natural disturbance regimes including fire and fire-related flooding, debris flows and landslides (Dwire and Kauffman 2003). Many species have adapted life histories that are shaped by and may depend on disturbance events (Dunham et al. 2003; Bisson et al. 2003; Rieman et al. 2005). Amphibians in general are thought to retreat to moist or subterranean refuges and thereby suffer low mortality during natural fires (Russel et al. 1999, pp. 374–384 in USDI-FWS 2013a). Changes to the forest structure from long-term fire suppression may have created conditions that increase fire severity and intensity (McKelvey et al. 1996, pp. 1934–1935 in USDI-FWS 2013a). Severe and intense wildfires may reduce amphibian survival, as the moist and permeable skin of amphibians increases their susceptibility to heat and desiccation (Russell et al. 1999, p. 374 in USDI-FWS 2013a).

In the event of a wildfire there could be varied response depending on size and severity. A large, high severity fire could disrupt flow regime and alter stream channel dynamics. Soil water storage; baseflow; streamflow regime; peak flow; water quality (sediment, temperature, pH, ash slurry); and chemical characteristics can be affected by wildfire (Neary et al. 2005). If a wildfire followed by a large precipitation event occurred, accelerated erosion and increased sedimentation could occur and sediment potentially transported to the stream system via overland flow from burnt slopes and roads. Accumulations of sediment could reduce habitat for benthic macroinvertebrates. Meyer and Safford's (2010) review of fire literature indicates increases on fire frequency, size, total area burned and severity in the Sierra Nevada over the past 20-30 years.

The USFWS (2013a) noted that data on the direct and indirect effects of fire on SNYLF and YT are lacking. Neither direct nor indirect effects of prescribed or wildfire have been studied (USDI-FWS 2013a) and impacts from fire and fire management activities on historical populations for the SNYLF and YT are unknown as well. Wildfires were listed with a potential direct mortality threat to the YT. Fire management was listed as a risk to Yosemite toad habitats, noting that the long history of fire suppression may have contributed to conifer encroachment in meadows. Small fires were noted as controlling encroaching conifers and large fires may determine the boundaries between meadows and forests (USDI-FWS 2013a and citations within). Recent telemetry study on YT adult dispersal indicates YT utilize a variety of upland habitats not associated with moist areas (Liang 2010). These areas include rodent burrows associated with old stumps, burrows located in open road cutbanks or the perimeter of lupine open areas. During summer months, they were not found to be located in areas of heavy concentrations of downed materials which would most likely burn hottest during fires.

Range: Two grazing allotments are authorized in the aquatic analysis area for French Project area: Chiquito and Haskell. There are approximately 363 cow/calf pairs permitted to graze in the allotments (Table 11). Actual use differs annually depending on economics, weather conditions, market conditions, etc. Not all of the allotment units overlap the aquatic analysis area or Project area. Potential habitat, which is assumed to be occupied for this purposes of this analysis, is present in the aquatic analysis area and the Project area for SNYLF, YT, CRLF, WPT or FYLF.

Table 11. Allotments and use within the Project area

Allotment	Livestock Numbers and Kind			Period of Use	
Chiquito	158	cattle	cow/calf	June 1	September 30
Kaiser	205	cattle	cow/calf	July 1	September 30

Cattle grazing can alter stream channel function, which impacts natural processes, reduces habitat diversity and complexity for aquatic or riparian animals (Elmore and Beschta 1987; Clary and Webster 1989; EPA 1991; Meehan 1991; Belsky et al. 1999). Grazing can affect water quantity by changing the pattern and timing of runoff, or increase sediment loads through removal of riparian vegetative cover and trampling of streambanks. Hydrologic alteration can result in changes to channel morphology, resulting in channel downcutting, over-widening and lowering of the water table. Animal wastes can directly impair water quality through bacterial contamination and increasing nutrient levels (EPA 1991). Additionally, movement of cattle within riparian zones can lead to reductions in stream shading and compaction of stream banks (Meehan et al. 1991; Armour et al. 1994). All of these factors can result in negative effects to habitat for aquatic/riparian species.

Wet meadows provide important breeding habitat for Yosemite toads and important forage for livestock (Roche et al. 2012a, Roche et al. 2012b). Livestock grazing may have detrimental impacts on Yosemite toads through trampling, alteration of meadow habitat, and lowered water quality (Martin 1992, 2008). Livestock grazing was historically widespread in the Sierra Nevada and historically caused widespread degradation of meadows (Menke et al. 1996). Some grazing practices, more commonly used in the past, have the potential to lower water tables resulting in less available water and shorter periods of water retention in breeding sites (Armour et al. 1994, Menke 1996, Belsky et al. 1999, USDI-FWS 2013a). Other effects from livestock grazing potentially pertinent to the toad are reduced vegetation cover (potentially positive or negative, Bull and Hayes 2000) and trampling of animals (Bartelt 1998). In a 3 year parallel study to a 5 year Adaptive Management Study addressing the effectiveness of excluding cattle from breeding areas (via fencing) (Tate et al. 2010, Roche et al. 2012a), there were no major differences in water quality attributes between breeding pools of the nine treatment meadows indicating overall excessive nutrient loading to breeding pools did not appear to be a concern in those nine meadows under standard USFS grazing management (Roche et al. 2012a, Roche et al. 2012b).

Grazing of these allotments is an ongoing activity and will occur during project implementation. Many of the effects on aquatic habitat and species listed above have been attributed to “prolonged use” of riparian areas by cattle and have caused cumulative effects to habitat still present today. Some of the effects described in literature are noted as resulting from historical “heavy” or “overgrazing”. Mention of these effects does not indicate that they are currently occurring or anticipated. It is expected however that current cattle grazing is resulting in some exposed streambanks, erosion, or trampling in localized areas. Forest Service standards and guidelines, along with BMPs (USDA-FS 2000) and utilization standards have been developed to improve rangeland condition, reduce effects and protect aquatic systems. Administration of cattle allotment permits (implementation of actions to protect sensitive habitat and species, etc.) can aid in the restoration of riparian area and other habitat.

Climate Change: Climate change has been suggested as a contributing agent in the decline of amphibians (Pounds and Crump 1994; Stewart 1995; Pounds et al. 1999). Global climate change potentially caused by the accumulation of greenhouse gases and reduction of the ozone layer are now being linked to species declines. This raises serious questions about the future of amphibians in areas of high vulnerably, particularly species with specialized habitat requirements (Semlitsch 2000). Reaser and Blaustein (in Lannoo 2005) summarize that site specific review of amphibian declines indicate possible global changes, and that regional warming, increasing ultraviolet radiation, and diseases are a potential result of global change. California anticipates warmer temperatures, accompanied by altered patterns of precipitation and runoff related to climate change

(DWR 2007). Annual runoff in the San Joaquin River basin has declined by 19% over the past 100 years, and projected precipitation alterations could reduce the snowpack by 25% by the year 2050.

Climate change is projected to alter temperature and precipitation regimes (Field et al. [IPCC] 2007 and citations within) and it is expected that patterns may change within the aquatic analysis area over time. The Project is within an elevation zone characterized as having warm/hot summers (varies by elevation) and cool/cold winters. Winter snow pack drives the hydrologic cycle in the Sierra Nevada where most annual precipitation above 5,500 feet elevation falls as snow between December and April. Change is expected to be reflected through an increase in daily maximum, minimums, and mean air temperatures, along with altered rainfall patterns. As climatic temperatures increase, more precipitation is projected to fall as rain versus snow resulting in more rain on snow events, earlier snowmelt, and smaller spring snowpacks.

Thompson (2005) summarizes that direct solar radiation has the greatest influence on water temperature, thus managing to maintain or improve shade is important to reduce heat flux. Precipitation changes would be expected to reflect a great deal of variability. Information from Meyer and Safford (*ibid*) project an increase in annual precipitation of 2.1 inches at Huntington Lake over the 10-year period, but the projections at Grant Grove in Kings Canyon National Park project no change. The major drainages in the Project area are influenced by snowmelt runoff. Spring runoff is occurring earlier in the year and fraction of runoff occurring in the spring is decreasing. With less snowfall expected to result from elevated air temperatures associated with climate change, it is likely that less water would be available during the late summer and that the water would be warmer than current conditions. Warmer water, changes in stream flow, and the increasing frequency and intensity of other disturbances are among the factors associated with climate change that are likely to impact native trout populations (Williams et al. 2009). Stress from climate change is likely to compound existing problems associated with habitat degradation.

Over the short-term (annually), the factors of variability in air or water temperature, precipitation, and the hydro-period of species environments, can influence reproductive success rates and survival to metamorphosis. Over the long term, the frequency and duration of extreme temperature and precipitation events can influence the persistence of populations and structure of meta-populations on the landscape. The net effect of less water and higher temperatures would be a reduction in the quantity and quality of aquatic/riparian habitat. Herpetofauna would likely be concentrated at sites where water is available, increasing their susceptibility to predators at these sites. The changing conditions of habitat would provide conditions more favorable for invasion by species currently occurring at lower elevation sites, and possibly an increase in non-native species.

Cumulative Watershed Effects: A cumulative watershed effects (CWE) assessment was conducted for the Project following the direction set forth in FSH 2509.22 (Stone 2015) to determine the potential for cumulative watershed effects in the affected watersheds in the Project area. All of the past, present, and reasonably foreseeable activities and the existing condition of each sub-drainage was considered in an evaluation of existing CWE concerns. A cumulative watershed effect would result in habitat degradation for aquatic/riparian species. The CWE model is based on a premise that watersheds will respond to effects of disturbance when that sub-watershed reaches a geomorphic and hydrologic threshold, referred to as the Threshold of Concern (TOC). Cumulative watershed effects from the proposed action include potential changes in peak flows and/or increased sedimentation from accelerated erosion. An indicator of a cumulative watershed effect response could be one or more of the following: Equivalent roaded area (ERA) values above the lower TOC value, excessive filling of channel pools with fine sediment; unstable channel banks; and/or poor aquatic habitat.

Equivalent roaded areas (ERA's) and effects from the French Fire would recover rapidly for the first 3-5 years with full recovery expected in about 10 years, but overall recovery could be delayed by effects from the secondary insect mortality. In addition, if another fire occurs under conditions similar to the French Fire, the increased fuel loading in insect affected areas would increase the potential for high burn severity. This could result in another episode of CWE's that would be reflected by another spike in ERA's. An increase in ERA's could result in reduction or degradation of aquatic habitat through pool sedimentation.

3.2.4. Alternative 2 (Proposed Action)

Based on potential habitat, which is assumed to be occupied, there five aquatic/riparian TES species with habitat in the project area: Sierra Nevada yellow-legged frog (SNYLF), Yosemite toad (YT), California red-legged frog (CRLF), western pond turtle (WPT), and foothill yellow-legged frog (FYLF) (Refer to Aquatic BE/BA,).

Direct and Indirect Effects

Direct effects to SNYLF, CRLF, WPT, and FYLF may include crushing or disturbing their habitats, including sheltering habitat (i.e. burrows, logs, stumps) as a result of the mechanical or project-related ground disturbing activities proposed. Adverse effects to species' habitat would be reduced through application of project design criteria, S&G's and BMP's. However, the following effects are anticipated:

SNYLF suitable habitat would receive roadside hazard removal treatment, vehicle use, and road maintenance, which could result in crushing or disturbing individuals and habitat. Immediately adjacent to SNYLF suitable habitat areas, treatments would include first and second entry logging, plantations, and powerline clearing.

YT suitable habitat would not receive any treatments. The only treatment that would occur immediately adjacent to YT habitat is DFPZ clearing. Herbicide use as part of DFPZ work would maintain an additional 25-foot buffer from YT habitat. All DFPZ work adjacent to YT habitat, including herbicide work, is below 6,000' elevation, so downslope movement of YT toward DFPZ areas is not anticipated. Project effects to YT individuals or habitat are not expected at any spatial or temporal scale.

CRLF suitable habitat would receive roadside hazard removal, vehicle use, and plantation treatments. Roadside hazard removal and vehicle use could result in crushing or disturbing individuals and habitat. Plantations would involve extensive site manipulation, including application of glyphosate with R11 surfactant directly in habitat, which represents several potential avenues for adverse effects to individuals and habitat. Roadside hazard removal, vehicle use, and plantation treatments would also occur immediately adjacent to CRLF habitat.

WPT and FYLF suitable habitat would receive all proposed categories of treatment (first and second entry logging, plantations, roadside hazard removal, DFPZ, and powerline clearing).

Additional indirect effects to TES species or their habitat as a result of implementation of alternative 2 can be attributed primarily to changes in terrestrial or aquatic habitats. These effects include sediment into streams or meadows from soil disturbances, soil contamination due to application of herbicides, changes in riparian cover, increase in stream temperature, crushing of rodent burrows with mechanical equipment, walking on and disturbing habitats during any project treatment, soil compaction due to equipment, log skidding, or end-lining methods, displacement or removal of cover objects, and reduction of herbaceous and wood cover due to prescribed burning. These affects can occur during and after treatments and impact individuals or habitat structure later in time. Herbicide treatments in areas adjacent to suitable habitat would be applied using a 25-foot buffer, and are not expected to affect habitat. An exception to the 25-foot herbicide buffer would occur in CRLF habitat, which would receive plantation treatment in and adjacent to habitat.

Indirect effects to the SNYLF, CRLF, WPT, and FYLF and their habitat from sedimentation, road decommissioning, herbicide application, a reduction of canopy or food, or an increase in stream temperature from implementation of the Proposed Action would be minimal. No indirect effects are expected for YT because all treatments are downslope from habitat. All treatments in units will follow SMZ's described in the design criteria, as well as BMP's outlined in the hydrologist report (Stone 2015). Additionally, project design criteria outlined previously would be followed, consistent with Forest standard and guidelines.

SNYLF: First and second entry logging, plantations, and powerline clearing would all occur immediately adjacent to five, four, three, and one SNYLF suitable habitat areas, respectively. Indirect effects to SNYLF habitat of logging, plantations, and powerline clearing could occur through watershed connectivity. However,

this is unlikely to take place, since design criteria, S&G's, and BMP's are in place to prevent detrimental effects to non-treatment areas. Specifically, design criteria #21 extends the no-disturbance SMZ's in SNYLF habitat to 100 feet on either side of the channel (Appendix D), effectively providing an additional 18-foot buffer to suitable habitat from adjacent project activities, and further protecting SNYLF habitat. Herbicide use will be even further buffered by an additional 25 feet from SMZ's (design criteria #25), providing a total no-spray buffer of 43 feet from SNYLF habitat, making the potential for exposure of SNYLF to herbicides extremely low. Stream crossings would be designed to not create barriers to passage (design criteria #39), and be constructed when the water table is low (design criteria #42), which would allow SNYLF to remain in the stream during dispersal periods, and help reduce their likelihood of crossing roads and coming in contact with vehicles. Stream sedimentation would be minimized by limiting mechanical operations on steep slopes and during wet periods (design criteria # 155, 156, 152), subsoiling (design criteria #153), providing soil cover (design criteria #157, 159, 160, 161), endlining within SMZ's (design criteria #158), and using aggregate to stabilize road surfaces within SMZ's (design criteria #162).

CRLF: Roadside hazard and vehicle use would occur immediately adjacent to both CRLF habitat areas in treatment. Indirect effects to CRLF habitat of logging, vegetation treatments, plantations, and vehicle use could occur through watershed connectivity. However, this is unlikely to take place, since design criteria, S&G's, and BMP's are in place to minimize detrimental effects to non-treatment areas. Specifically, design criteria #20 prevents mechanical treatments within 100 feet of streams with CRLF potential habitat (Appendix D), providing an additional buffer to CRLF habitat. Stream crossings would be designed to not create barriers to passage (design criteria #39), and be constructed when the water table is low (design criteria #42), which would allow SNYLF to remain in the stream during dispersal periods, and help reduce their likelihood of crossing roads and coming in contact with vehicles. Stream sedimentation would be minimized by limiting mechanical operations on steep slopes and during wet periods (design criteria # 155, 156, 152), subsoiling (design criteria #153), providing soil cover (design criteria #157, 159, 160, 161), endlining within SMZ's (design criteria #158), and use aggregate to stabilize road surfaces within SMZ's (design criteria #162). Also, all treatments within and adjacent to CRLF habitat would occur no closer than 100 feet from the stream, therefore treatment effects are not expected to reach the SMZ or the waterway.

WPT: Nearly all of the WPT suitable habitat areas would receive vehicle use, and would have vehicle use adjacent to habitat. Vehicle use and road maintenance and reconstruction could result in direct crushing of individuals and small, short term increases in sediment delivery to streams through dust and activities such as blading. Vehicle use and road maintenance would coincide with logging activities, which will be most intense from fall 2015 through spring 2016. This timing coincides with WPT movements overland and along stream courses, and represents a possible effect to individuals in the form of crushing of individuals, and reduction in the quantity and quality of habitat through sedimentation. These potential effects would be minimized through application of a Limited Operating Period (design criteria #22) which would prohibit mechanical activities within 325 feet of perennial streams from October 1 through June 15. Additionally, stream crossings would be designed to not create barriers to passage (design criteria #39), and be constructed when the water table is low (design criteria #42), which would allow WPT to remain in the stream while moving, and help reduce their likelihood of crossing roads and coming in contact with vehicles. Stream sedimentation would be minimized by limiting mechanical operations on steep slopes and during wet periods (design criteria # 155, 156, 152), subsoiling (design criteria #153), providing soil cover (design criteria #157, 159, 160, 161), endlining within SMZ's (design criteria #158), and using aggregate to stabilize road surfaces within SMZ's (design criteria #162).

FYLF: Nearly all of the FYLF suitable habitat areas would receive vehicle use, and would have vehicle use adjacent to habitat. Vehicle use and road maintenance and reconstruction could result in direct crushing of individuals and small, short term increases in sediment delivery to streams through dust and activities such as blading. Vehicle use and road maintenance would coincide with logging activities, which will be most intense from fall 2015 through spring 2016. This timing coincides with FYLF movements overland and along stream courses, and represents a possible effect to individuals in the form of crushing of individuals, and reduction in the quantity and quality of habitat through sedimentation. These potential effects would be minimized through application of a Limited Operating Period (design criteria #22) which would prohibit mechanical activities within 325 feet of perennial streams from October 1 through June 15. Additionally, stream crossings would be designed to not create barriers to passage (design criteria #39), and be constructed when the water table is low (design criteria #42), which would allow FYLF to remain in the stream while moving, and help reduce their likelihood of crossing roads and coming in contact with vehicles. Stream sedimentation would be minimized by limiting mechanical operations on steep slopes and during wet periods (design criteria # 155, 156, 152), subsoiling (design criteria #153), providing soil cover (design criteria #157, 159, 160, 161), endlining within SMZ's (design criteria #158), and using aggregate to stabilize road surfaces within SMZ's (design criteria #162).

Based on best available science and the implementation of the Project's design criteria, the herbicide impact to aquatic species would be negligible.

Cumulative Effects

As discussed in the No Action Alternative, a wide range of activities have occurred and continue to occur across the landscape, which in combination represent the potential to cumulatively effect individuals or habitat for aquatic/riparian species. Past, present and reasonably foreseeable actions within the project area are displayed in the No Action section. Known activities occurring spatially and temporally within the analysis area include transportation management; vegetation management; recreation and facilities; fire (wildfire); and range (cattle grazing).

Most of the Forest Service actions that can contribute to cumulative effects for SNYLF, YT, CRLF, WPT, and FYLF over the past decade, along with those proposed in the next decade, relate to fuels reduction, roads, or cattle grazing. These actions have BMPs (USDA –FS 2011), along with Forest Standard and Guidelines to restrict off-site erosion and activities within SMZ's. Literature has shown BMP's to be effective in minimizing the erosion in treatment areas and at preventing sediment from reaching streams. In a study of sediment redistribution after harvesting, Wallbrink and Croke (2002) found that sediment derived from skid trails was deposited both within the treated area and the stream buffers (23-30 m). BMP's are expected to protect stream channels from sediment for treatments areas near streams (where applicable). Monitoring of BMP's on Forest Service lands in California has shown that, when implemented, timber management BMP's are 95-98% effective (USDA-FS 2011).

By helping to restore the vegetation in the project area, reducing fuel loading caused by the French Fire and improving road conditions that access treatments, there may be additional temporary increases in sediment to the aquatic ecosystem from all activities proposed under the Proposed Action. However, the increases in sediment to waterways are expected to be short in duration (1-3 years), and therefore cumulative effects to SNYLF, CRLF, WPT, and FYLF or their habitat from the implementation of treatments are expected to be minimal, with no effects expected for YT.

Based on the CWE analysis (Stone 2015), increasing groundcover in treatment units will help prevent erosion in these areas when it is most likely to occur, which is within the first few years following a fire. BAER road work does not affect the ERA model but would help lower risk of cumulative watershed effects by minimizing road surface erosion, disconnecting road/stream connectivity, and removing or replacing culverts that are undersized for the larger post-fire flows that are expected. Overall, the project would have minor positive effects where more groundcover was left on the slopes, particularly on steeper slopes and in SMZ's in High SBS areas.

However, the overall change in condition of the watersheds from the project would be negligible and unmeasurable. Fire effects would still dominate watershed response, even if the project mitigates them somewhat in limited areas.

3.2.5. Alternative 3 (No Herbicide)

Direct Effects and Indirect Effects

The effects described for the use of glyphosate do not apply to this alternative. Using mechanical means to control bear clover for reforestation (e.g., blading or tilling) would require the clearing (by dozer piling) each area of downed woody material to allow for effective mechanical release. The loss of ground cover and disruption of the soil structure over 2,300 acres would exacerbate CWE conditions, potentially leading to accelerated erosion and sediment delivery to streams. As such, hand grubbing would be the only viable option in avoiding a CWE response. If mechanical means are employed, the resulting increase in sediment delivered to streams would result in reduction in pool habitat for SNYLF, CLRF, WPT, and FYLF. Herbicides would not be used in CRLF habitat or adjacent areas, but the effects would remain similar because ground disturbance would still be extensive.

Cumulative Effects

The post-fire watershed response would be the same as those described for alternative 2 (Stone 2015). The lack of herbicide does not change the cumulative effects of this alternative. Therefore, the cumulative effects would be the same as described for alternative 2.

3.2.6. Alternative 4 (Hazard Tree and Plantation Salvage Only)

Direct Effects and Indirect Effects

The effects of this alternative would be the same as described for Alternative 2.

Cumulative Effects

According to Stone (2015), watershed ERA's would be similar to Alternative 2, but slightly lower in 16 sub-drainages. Two sub-drainages would have decreased CWE potential. Less disturbance is slightly beneficial to watersheds; however, the post-fire response would still dominate at all scales, and there would be no difference in cumulative effects. The cumulative effects of this alternative would be the same as described for Alternative 2.

3.2.7. Alternative 5 (No Secondary Entry)

Direct Effects and Indirect Effects

The effects of this alternative would be the same as described for Alternative 2.

Cumulative Effects

According to Stone (2015), two sub-drainages would have slightly lower %ERA values, but the CWE response potential would remain the same. As such, the cumulative effects of this alternative would be the same as described for Alternative 2.

Summary of Effects for all Alternatives

The determinations for each of the threatened, endangered, and Forest Service sensitive species is shown in Table 12 and 13 for the Project. Determinations consider new information on current species including new studies or information in federal registers, local species occurrence and the viability assessments for these species completed under the SNFPA (USDA-FS 2001, 2004) completed at the bioregional scale, local species occurrence and distribution of habitat within the analysis area, and apparent overlap of habitat. The 2001 Viability Assessment (SNFPA FEIS Volume 3, Chapter 3, part 4.4) considered habitat for MYLF (SNYLF), and YT to range from patchy to isolated, and that the selected Alternative (Modified 8) to be among alternatives evaluated as appearing to have the lowest risk and the most effective management approaches for these species persistence and recovery. Silvicultural thinning/fuels reduction was among the management actions considered in the Viability Assessment. The aquatic management strategy accompanying the SNFPA includes standards and guidelines to reduce effects from Forest Service management actions and maintain or improve habitat for herpetofauna. Table 12 and 13 display the determination of effects for SNYLF, YT, CLRF, WPT, and FYLF based on known information on species, habitat available, literature review, and anticipated effects.

Table 12. Effects determinations for Alternative 1 (No Action) for all TES species and their associated habitats.

Species / Status / Critical Habitat	Determination for Alternative 1	Rational for the Determination
Sierra Nevada yellow-legged frog *Endangered, FS Sensitive*	*No effect*	No treatments or activities are proposed, therefore, there will be no impacts from treatments to species or habitat from Alternative 1
Sierra Nevada yellow-legged frog proposed critical habitat	*Will not affect proposed critical habitat*	No treatments or activities are proposed, therefore, there will be no impacts from treatments to proposed critical habitat from Alternative 1
Yosemite toad *Threatened, FS Sensitive*	*No effect*	No treatments or activities are proposed, therefore, there will be no impacts from treatments to species or habitat from Alternative 1
Yosemite toad proposed critical habitat	*Will not affect proposed critical habitat*	No treatments or activities are proposed, therefore, there will be no impacts from treatments to proposed critical habitat from Alternative 1
California red-legged frog *Threatened*	*No effect*	No treatments or activities are proposed, therefore, there will be no impacts from treatments to proposed critical habitat from Alternative 1
California red-legged frog critical habitat	*Will not affect critical habitat*	No treatments or activities are proposed, therefore, there will be no impacts from treatments to proposed critical habitat from Alternative 1
Foothill yellow-legged frog *FS Sensitive*	*No effect*	No treatments or activities are proposed, therefore, there will be no impacts from treatments to proposed critical habitat from Alternative 1
Western pond turtle *FS Sensitive*	*No effect*	No treatments or activities are proposed, therefore, there will be no impacts from treatments to species or habitat from Alternative 1

Table 13. Effects for Alternative 2-5 for all TES species and their associated habitats.

Species and status / Critical Habitat	Determination for Alternatives 2-5	Rational for the Determination
Sierra Nevada yellow-legged frog *Endangered, FS Sensitive*	*May affect, likely to adversely affect*	• 41 acres of suitable habitat would receive roadside hazard removal treatment, which could result in crushing or disturbing individuals and habitat. • Vehicle use, road maintenance, and road reconstruction could result in crushing individuals and short term increases in sediment delivery to streams. • Treatments adjacent to habitat include first and second entry logging, plantations, roadside hazard removal, and powerline clearing.
Sierra Nevada yellow-legged frog proposed critical habitat	*Will not affect proposed critical habitat*	• No treatments or activities are proposed within proposed critical habitat. • The aquatic analysis area is outside of proposed critical habitat
Yosemite toad *Threatened, FS Sensitive*	*No effect*	• No treatments are proposed in suitable habitat. • The only treatment adjacent to habitat is DFPZ. All DFPZ work adjacent to habitat, including herbicide work, is below 6,000' elevation, so downslope movement of YT toward DFPZ areas is not anticipated. Additionally, herbicide use as part of DFPZ work would maintain a 25-foot buffer from habitat.
Yosemite toad proposed critical habitat	*Will not affect proposed critical habitat*	• No treatments or activities are proposed within proposed critical habitat. • The aquatic analysis area is outside of proposed critical habitat
California red-legged frog *Threatened*	*May affect, likely to adversely affect*	• 4 acres of suitable habitat would receive roadside hazard removal treatment, which could result in crushing or disturbing individuals and habitat. The 4 acres would also receive vehicle use, which could result in crushing individuals. • 2 acres of suitable habitat would receive plantation treatment, resulting in extensive site manipulation and use of herbicides. • Treatments adjacent to habitat include plantations and roadside hazard removal.
California red-legged frog critical habitat	*Will not affect critical habitat*	• No treatments or activities are proposed within critical habitat. • The aquatic analysis area is outside of critical habitat
Foothill yellow-legged frog *FS Sensitive*	*May affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability*	• Suitable habitat would receive all proposed categories of treatment (first and second entry logging, plantations, roadside hazard removal, DFPZ, and powerline clearing (except habitat would not receive herbicides in Alt 3, first or second entry in Alt 4, or second entry in Alt 5)). • Design criteria will help to reduce some direct and indirect effects.
Western pond turtle	*May affect individuals, but is*	• Suitable habitat would receive all proposed categories of treatment (first and second entry logging, plantations,

Species and status / Critical Habitat	Determination for Alternatives 2-5	Rational for the Determination
FS Sensitive	*not likely to result in a trend toward Federal listing or loss of viability*	roadside hazard removal, DFPZ, and powerline clearing (except habitat would not receive herbicides in Alt 3, first or second entry in Alt 4, or second entry in Alt 5)). • Design criteria will help to reduce some direct and indirect effects.

3.3. Botanical Resources

The information presented in the Botanical Resources section is summarized from the French Fire Recovery and Reforestation BA/BE for TES Plants (Clines 2015a) and the Invasive Weed Risk Assessment (Clines, 2015b), both of which are hereby incorporated by reference. In addition to literature cited in the sections on native plant diversity and recovery; observations made over the last two decades on post-fire vegetative recovery are used. The majority of these observations are in the form of notes and photographs, in the files of the Forest Botanist.

3.3.1. Background and Affected Environment

This analysis focuses on three, interrelated topic areas:

1. Native plant diversity and recovery - the early seral component of the vegetation after fire and after the suite of proposed treatments under each alternative;

2. Effects of the alternatives on Forest Service sensitive (FSS) plant species (no federally Threatened or Endangered plants occur),

3. The effectiveness of each alternative in meeting the purpose and need of the Project of keeping native vegetation communities free from invasive weeds.

Native Plant Diversity and Recovery

During scoping, issues were raised by the public about the importance of preserving native plant diversity in the French Fire area, especially during the first year or two after the fire when species that are cued to germinate by fire are most abundant. Concern was expressed that the herbicide treatments for reforestation and invasive weed control would impact the diverse native herbaceous flora that proliferates after wildfire. The contribution of Complex Early Seral Forests (CESF) to overall temporal and spatial diversity of ecosystems within the French Fire is another issue of interest to the public. This section of the EA is focused on the response of the native vegetation to the fire, especially the immediate post-fire environment, and the Proposed Action and alternatives.

Indicators

The effects of the alternatives were evaluated using the following three indicators. The indicators were selected as being measurable and relevant for comparing the effects of proposed activities to native plant recovery, sensitive plants, and invasive weed control efforts. Increased area occupied by invasive weeds can create negative effects on FS sensitive plant species. Vegetation and fuels treatments can reduce the area or number of occurrences of sensitive plants.

Indicator 1: For Native Plant Diversity and Recovery, the proportion of burned acres not treated (not undergoing ground-disturbing activities) is a proxy for the amount of early successional vegetation not altered by management activities; and for allowing fire-induced ecological processes to occur.

Areas within the burn area not subject to treatment are assumed to allow ecosystems to respond naturally to burning by:

- Producing seedlings of herbaceous and woody species from the soil seed bank, which reach reproductive maturity and contribute seeds back to the soil seed bank;
- Allowing re-sprouting shrubs and perennials to mature, flower, and produce seeds that also replenish the soil seed bank.
- The presence of this post-fire early successional flora creates a window of opportunity for native insects (many of which are pollinators) to boost population sizes; more plentiful native plants and insects lead to increased use of the areas by birds and other wildlife.

In addition, it is assumed that areas of bear clover and other native shrubs, once treated with herbicides for reforestation, would likely have increased cover of non-native annual grasses and forbs (McGinnis, et al. 2010); some of which may be invasive; thus the number of acres not treated would not have this phenomenon Affected Environment.

Indicator 2: Number of FS sensitive plant occurrences and their aerial extent (in square meters, miles of stream, or acres).

Ideally, the number of occurrences and their extent would remain the same or increase.

Indicator 3: Number of invasive weed infestations and their aerial extent (in square meters or acres).

Ideally, the number of infestations and their extent would decrease as a result of weed treatments proposed in the action alternatives. In addition, evidence of successful Early Detection/Rapid Response would be measured by the number of invasive weed infestations discovered early and controlled rapidly in time for eradication to occur within the life of the Project.

Native Vegetation Diversity and Recovery

Native vegetation of the Sierra Nevada is adapted to fire and many species are either resistant to fire (e.g. thick bark) or stimulated by fire (e.g. sprouting, smoke-induced germination, seed release) (Fites-Kaufman et al., 2006). While most of the fire area is generally expected to recover the pre-fire vegetation it supported, the trajectory and pace of recovery may be atypical in some areas due to extreme drought conditions from 2012 through 2015. The French Fire occurred during a time of drastically low fuel moisture levels. As a result, complete consumption of ground cover (duff, litter, and downed wood) and soil organics (including roots and probably the seed bank at some sites) occurred in the highest severity areas. In these areas, re-sprouting may not occur and seed input may be more dependent on long-distance dispersal via animals, soil movement, and wind. It is important to note that although a high proportion of the French Fire had moderate (48%) or high (10%) soil burn severity; this does not necessarily mean that the seed bank is depleted or that sprouting of shrubs and trees (including oaks) will not occur in these areas.

Historically (prior to fire suppression policies) the native vegetation would have regularly experienced a patchwork of burn intensities (mixed fire severities) including high severity. The heterogeneity and resilience of Sierra Nevada mid-elevation forests was maintained prior to fire suppression policies by relatively frequent fire occurring on average 7-16 years (van Wagtendonk and Fites-Kaufman, 2006).

The concept of Early Successional Forest Ecosystems (ESFE) (Swanson et al., 2010), Complex Early Seral Forests (CESFs), “structurally complex early-successional stands” (Noss et al., 2006) has become a topic of research and discussion recently. There is recognition that the high native biotic diversity present after a wildfire is temporally and spatially rare when considered across large landscapes. The first years directly after fire are characterized by a crucial pulse of germination, re-sprouting, and abundant flowering of a myriad of plants found to a greater or lesser degree in all burn severities. Also relevant to this section are the findings of a study by McGinnis et al. (2010) of four Sierra Nevada fires where salvage logging, fuels treatments, and

herbicides for site prep and reforestation were carried out. In areas where herbicides were used to control competing shrubs during reforestation (as is proposed under Alternatives 2, 4, and 5 for the French Fire RRP), the presence of nonnative annual grasses was greater than in areas not treated with herbicides; and potentially these flashy grass fuels would make frequent reburns more likely, which would further perpetuate non-native annual grasses and possibly other non-native or invasive plants.

The majority of the French Fire area had not burned in at least 100 years (please see Fire and Fuels section for further information). The absence of fire for about a century combined with the lack of recent fuels reduction projects resulted in extreme accumulation of duff, litter, and coarse fuels, especially in forest stands. The soil seed bank has been accumulating seeds for at least 100 years; a substantial proportion of these seeds are viable for many decades and will germinate *en masse* where conditions are suitable and the proper cues are received (e.g. extreme heat, smoke, leachate).

Vegetation types within the French Fire area by CWHR (2015) as mapped during BAER are shown in Table 14, along with burn severity for each type (Engelhardt et al., 2014). The primary types are montane hardwood, ponderosa pine forest, mixed conifer forest, foothill and montane chaparral and a small amount of blue oak woodland in the southern, lower elevation areas. Soil burn severity in the French Fire was 10% unburned/very low, 32% low, 48% moderate, and 10% high; soil burn severity by CWHR vegetation type follows a similar pattern with the highest proportion in moderate severity for most types. Soil burn severity can be used as a surrogate for vegetation burn severity, where areas of high severity result in complete or partial consumption of above ground vegetation. Areas of moderate soil burn severity typically exhibit low to high vegetation mortality and areas of low soil burn severity result in vegetation persistence in the post-fire environment).

Table 14. Vegetation types within the French Fire shown by burn severity. Vegetation types are based on the California Wildlife Habitat Relationship (CWHR) classifications.

Vegetation type (CWHR types)	Soil burn severity	Acres	% of Acres	Total acres
Annual grassland	Low	5.4	86	6.3
	Moderate	0.9	14	
Blue oak/gray pine woodland	Low	0.03	1	3.9
	Moderate	3.1	79	
	High	0.8	21	
Blue oak woodland	Unburned/Very low	3.9	17	23.4
	Low	12.9	55	
	Moderate	6.6	28	
Mixed chaparral	Unburned/Very low	243.5	23	1037.7
	Low	356.1	34	
	Moderate	402.5	39	
	High	35.6	3	
Montane chaparral	Unburned/Very low	69.2	21	333.1
	Low	101.6	31	
	Moderate	145.5	44	
	High	16.8	5	
Montane hardwood- conifer	Unburned/Very low	247.1	9	2898.5
	Low	919.4	32	
	Moderate	1399.1	48	
	High	332.9	11	
Montane hardwood	Unburned/Very low	310.9	7	4671.2
	Low	1391.9	30	
	Moderate	2508.9	54	
	High	459.5	10	
Ponderosa pine	Unburned/Very low	151.8	7	2214.1
	Low	692.4	31	
	Moderate	1073.8	48	
	High	296.1	13	
Red fir	Unburned/Very low	1.5	65	2.3
	Low	0.8	35	
Sierra mixed-conifer	Unburned/Very low	167.6	7	2259.9
	Low	804.4	36	
	Moderate	1005.5	44	
	High	282.4	12	

A brief review of the scientific literature and field observations on floristic diversity after fire by Forest Service botanists since 1990 allows some predictions of how plants in the French Fire area will respond in 2015 and the next few years.

All the vegetation types in the French Fire area accumulate seeds of native herbaceous and woody species in the soil seed bank between fires or other disturbance events. Numerous species have seeds that are cued to germinate by the heat of fire or by smoke (or sooty rainwater); thus they only appear the first (and sometimes second) year after fire. An enormous amount of the plant species diversity in the vegetation of the Project area occurs in a temporally rare pulse after fire. In the area burned by the Aspen Fire of 2013, golden eardrops (*Ehrendorfia chrysantha*) (Figure 3); a fire-follower that requires smoke to germinate, was found in abundance on a west-facing slope that burned at low to moderate severity. Other fire followers typically appearing the year after a fire in the SNF are whispering bells (*Emmenanthe penduliflora*) busy blazingstar (*Mentzelia dispersa*), and Venus' looking-glass (*Triodanis biflora*)..

Figure 3. Left: Fire-follower golden eardrops in Aspen Fire area, July 1, 2014, Right: Same slope showing stumps after roadside hazard tree removal earlier in 2014. Diverse native plant growth from seed and sprouting were observed at this site. Photos: J. Clines

Fire-stimulated flowering is commonly seen the first year or two after fire in native bulb-forming plants such as Mariposa lilies, brodiaeas, fritillaries, death camas; and other perennials. In the Aspen Fire, on June 5, 2014, on a high burn severity slope east of Stump Springs Road and just south of Saddle Creek; a profusion of snake lilies (*Dichelostemma volubile)* and butterfly mariposa lilies (*Calochortus venustus*) was observed and photographed (Figure 4). The lower left photo does not do justice to the sheer quantity and cover of snake lily, which is normally a somewhat sparsely distributed wildlflower that climbs on other plants in a vine like manner.

Figure 4. Aspen Fire, high severity burn. Left: snake lily and sprouting shrubs, Middle: Mariposa lily in unusual shade of red, Right: Sierra Nevada helianthella, recovered from rhizomes. Photos: Stephen Shamoff.

Threatened, Endangered, and Sensitive Plants

No federally listed plants occur in the Project area. The SNF Botanist obtained the most recent list of proposed, candidate, and federally listed plants that may be found in the Project area from the US Fish and Wildlife Service web site (USFWS, 2015). Only one listed plant species occurs in the SNF: the Mariposa pussypaws (*Calyptridium pulchellum*). There are no known occurrences of Mariposa pussypaws in or near the Project area; which lies entirely above the elevation range for Mariposa pussypaws. Please see the BA/BE for Plants for further information (Clines, 2015a).

Table 15 shows the FSS plant species that are known to occur or have suitable habitat in the French Fire RRP; along with habitat information and where they occur if known to be in the project area. The BA/BE for Plants (Clines, 2015a) provides detailed species accounts and photographs for each of the nine species. Appendix A of the BA/BE explains why the other 50 SNF sensitive plant species are not analyzed (the rationale is generally that the project is outside of the distributional or elevation range for those species, or habitat is not present).

Table 15. FSS Plants in the French Fire Recovery and Restoration Project

Species	Occurrence in French Fire RRP Area	Habitat
Camissonia sierrae ssp. *alticola* (CASIA) **Mono Hots Springs Evening Primrose**	Detailed Analysis Unit 4: Occurrence CASIA-15-14	Rocky/Gravelly: Gravel and sand pans and ledges associated with outcrops in chaparral, ponderosa pine, mixed conifer and red fir/lodgepole forests, 4500 – 8500 feet.
Cinna bolanderi **Bolander's Reed Grass**	No occurrences known in project area, but suitable habitat present along perennial streams.	Riparian/Aquatic: Streamsides, wet meadows, moist sites in conifer forest. 6000-8000 feet.
Collomia rawsoniana (CORA2) **Rawson's Flaming Trumpet**	Populations along: Fish Creek (mostly moderate soil burn severity)	Riparian/Aquatic: Streamsides and meadow edges, 2500 – 7000 feet.

	Slide Creek (low soil burn severity) Rock Creek and tributaries (mostly low, some moderate soil burn severity) Unnamed tributary to Mammoth Pool (moderate and high burn severity)	
Fissidens aphelotaxifolius (FIAP) **Brook Pocket - Moss**	No occurrences known in project area, but suitable habitat present along perennial streams below 6400’	Riparian/Aquatic: Rocky substrate in streams, < 6400 feet.
Hulsea brevifolia (HUBR) **Short –Leafed Hulsea**	No occurrences known in project area, but suitable habitat present.	Forested: Granitic or volcanic soils in openings and under canopy in mixed conifer and red fir forest, 5000 – 9000 feet.
Leptosipon serrulatus (LESE18) **Mdera Leptosiphon**	No occurrences known in project area, but suitable habitat present south of Fish Creek.	Forested: Openings in foothill woodland / annual grassland and montane coniferous forest. 1000-5000 feet.
Lewisia disepala (LEDI3) **Yosemite Lewisia**	Detailed Analysis unit 4: Four occurrences on granitic gravel and on outcrops.	Rocky/Gravelly: Granitic sand and gravel in ponderosa pine, mixed conifer, and upper montane coniferous forest, 4000 – 7500 feet.
Lewisia kellogii ssp. *kelloggii* (LEKEK) **Kellogg’s Lewisia**	No occurrences known in project area, but may occur where LEDI3 occurs or in other areas of suitable habitat where rock outcrops are prominent.	Rocky/Gravelly: Open, gravelly flats in mixed conifer and subalpine forest, 6000 – 11,000 feet.
Peltigera gowardii **Veined Water Lichen**	One occurrence in Slide Creek – low soil burn severity One occurrence in a tributary to Rock Creek	Riparian/Aquatic: Cold, clear, unpolluted streams in conifer forests, 4000 – 8000 feet.

Invasive Plants

The invasive plants (noxious weeds) known from the fire area: *Elymus caput-medusae* (medusahead), *Bromus tectorum* (cheatgrass), and *Cirsium vulgare* (bull thistle). Medusahead is rated as having a *HIGH* ecological impact by the California Invasive Plant Council (Cal-IPC, 2006); there is a patchy infestation at the south end of the fire in the vicinity of the San Joaquin Mine and the Southern California Edison (SCE) power line. Cheatgrass and bull thistle are rated as *Moderate* and are sporadic within the fire area. These species pose a

degree of threat to the burned area because of their inherent invasiveness in the ecological communities present in and around the French Fire. However, cheat grass is generally a component of the mix of non-native annual grasses occupying disturbed sites in the central Sierra Nevada, rather than forming expansive monocultures as it does in the Great Basin and Mojave Desert. The SNF rarely treats cheatgrass, budgets are limited for weed treatments and other species are much higher priority; and it is ubiquitous and arguably less damaging than high-priority weeds such as yellow star thistle, medusahead, or spotted knapweed.

Bull thistle (*Cirsium vulgare*): Infestations of bull thistle are likely to occur within the Project area. The French Fire area is not known to have this weed but its pattern of distribution in the surrounding areas of the Forest suggests that it would be present. Although not as highly invasive as some other noxious thistles, bull thistle competes with and displaces native species and decreases forage values in meadows and uplands at elevations up to 7,000 feet (Randall, 2000). Cal-IPC (2006) rates bull thistle as having moderate ecological impact statewide, but notes that this species can be very problematic regionally, especially in riparian areas such as meadows and streamsides (Cal-IPC, 2006). Bull thistle has recently been documented at elevations higher than 7,000 feet in the Sierra Nevada (e.g. up to 8795 feet at Sonora Pass on the Stanislaus National Forest (UC Berkeley, 2015).

Medusahead (*Elymus caput-medusae*) is a winter annual grass and noxious rangeland weed that has spread across millions of acres in the western United States (Davies & Johnson, 2008). Seeds germinate or lose their viability after two years in the soil (DiTomaso et al. 2013). Uncrowded medusahead stands will produce six or more seed heads per plant (Murphy and Turner 1959), and a square meter of medusahead can produce 4,000 to 10,000 seeds (Harris and Goebel 1976). The plant has a high silica content which slows decomposition, leading to thatch accumulating to a depth of two to four inches, and only medusahead seeds will germinate through the thatch. It also has thicker cell walls than similar annual grasses, which allows it to pull nutrients and water from deeper layers of the soil than competing species.

Medusahead is almost worthless as forage for cattle and sheep, due to the high-silica content and barbed seed heads (Miller et al. 1999). It is estimated that grazing capacity is reduced by 50 to 80% after medusahead establishes (Hironaka 1961). Medusahead crowds out other annuals and generally outcompetes perennial grass seedlings. Where it is allowed to establish, it can form exclusive stands that effectively shut out other vegetation (Miller et al. 1999).

Mowing was shown to have mixed results in a study by DiTomaso et al. (2013) but is most effective when the grass is in the “boot” stage, where the developing seedhead is still in the leaf sheath and not yet flowering. Mowing after seed set will disperse the seeds and should be avoided. Raking or tilling the thatch that builds up can also be effective in allowing native species to re-establish (DiTomaso et al. 2013). Hand-pulling is an option only for very small infestations. Several herbicides are effective on medusahead, and herbicide treatment is a key tool for treating larger infestations.

There is a high risk that medusahead will spread in the fire area because 1) low-severity burned areas adjacent to infestations provide an ideal seed bed for establishment; 2) disturbance corridors such as dozer lines, roads, and power lines pass through infestations; 3) suppression equipment and crews passed through infestations and then moved to unknown uninfested areas within the fire; and 4) poles for SCE power line repairs were staged in infestations and then transported to various locations along the power line throughout the fire area. During planning for the Project, the medusahead polygons mapped during BAER as 19 gross acres were expanded based on field observations reported by FS workers to the IDT botanist and knowledge of dozer line locations in relation to infested areas. The result was 32 gross acres shown as potentially having medusahead. This allowed IDT specialists to analyze for treatment of medusahead anywhere within these polygons with glyphosate (except in buffer zones for TES aquatic wildlife and SMZs). Invasive weed surveys are underway in 2015, for this Project; and will continue each year as needed prior to initiation of different phases of the Project (e.g. site prep with herbicides and planting of conifers would be staggered over several years).

3.3.2. Environmental Consequences

General Direct Effects for Sensitive Plants

The following direct effects to sensitive Plants are possible during implementation of any of the action alternatives: direct killing of plants when equipment runs over them or parks on them, when logs are skidded or dragged over them, when slash piles crush plants and block their light, when piles are burned directly over them and the heat intensity is too great for plants or their seeds to survive; when herbicides are directly applied to them.

General Indirect Effects for Sensitive Plants

A possible indirect effect to FSS plants is the degradation or loss of habitat resulting from the introduction or spread of invasive and noxious weeds. These are non-native weeds that are particularly aggressive, and can spread rapidly and compete with native plants for water and other resources, in some cases forming solid stands that may replace or reduce the abundance of sensitive plants. Invasive weeds can be transported to new areas when vehicles and heavy equipment pass through or excavate soil in contaminated areas without being washed before moving to a new area. Noxious weed species known to occur within the Project area are medusahead and bull thistle.

At this time, the Project area is not known to have weed infestations aside from medusahead and a few patches of bull thistle. The most likely additional invasive weed species to occur in the Project area are: woolly mullein, Italian thistle, klamathweed, tocolote, stinkwort (*Dittrichia graveolens*), and smilograss (*Stipa miliacea* ssp. *miliacea)*. This is based on the presence of these weeds on nearby lands and at the USFS compound in North Fork where fire suppression and road maintenance equipment have been staged prior to traveling to the French Fire area. Heavy equipment may have brought seeds to the area during the first few days of initial attack prior to arrival of the equipment washing station at fire camp. Invasive weed prevention measures have been incorporated into the Alternatives 2-5, thus these indirect effects should be minimal. Please see the Invasive Weed Risk Assessment for further information (Clines, 2015).

3.3.3. Alternative 1 (No Action)

Direct and Indirect Effects

Native Plant Diversity and Recovery

Under the No Action alternative, there would be no direct effects to the native vegetation as no activities would occur. Further disturbance to the soil would not occur, and native plant biodiversity would not be affected by timber harvest, fuels cleanup, or site prep and reforestation under this alternative. Indirect effects to native vegetation would occur as medusahead continues to spread, occupying more acreage and replacing native plants.

Sensitive Plants

Sensitive Plants of Forested Habitats

Short-leaved hulsea is not known to occur within the Project, but there may be unknown populations, especially above 5000’. Madera leptosiphon occurs within lower montane coniferous forest and there may be undiscovered populations south of Fish Creek. However, for Madera leptosiphon, indirect effects may occur due to the spread of medusahead into suitable habitat because the herbicide treatments for medusahead would not occur over the number of years needed for eradication; and manual and mechanical methods conducted only for one year with BAER funds are not adequate to eradicate this invasive, aggressive grass.

Sensitive Plants of Riparian and Aquatic Habitat

While portions of Rawson's flaming trumpet occurrences burned and there may be some mortality in the hotter areas, recovery will occur from surviving individuals through resprouting and seedlings. In a study of the effects of disturbance after logging, livestock use, and fire (Liskey, 1993); flaming trumpet produced a higher percentage of flowering stems when canopy closure was reduced from 84 and 99% to 70 and 77% respectively. In the same study a clear-cut plot showed a slight increase in percentage of flowering stems when canopy cover went from 82 to 0%. Seedlings were more abundant after logging and fire and were strongly associated with mineral soil; therefore this species could benefit from the reduction in canopy cover as a result of the fire. Some ground disturbance (loosening of soil or clearing of duff as would have happened after wind-blow of timber or fire) may be beneficial but severe disturbance whereby a large tree is felled onto living flaming trumpet plants or is dragged through the soil creating a gouge would be detrimental. The No Action alternative would not involve further direct ground disturbance within flaming trumpet populations beyond what occurred during the fire, thus no direct effects or indirect effects are expected.

The population of western waterfan lichen at Slide Creek was observed to have some debris from the burned slope above during the French Fire BAER reconnaissance, however the stream should clear out and run clear over time. No direct or indirect effects would occur for the western waterfan lichen population at Slide Creek as a result of the No Action alternative as no timber harvest or road reconstruction would occur.

There are no known populations of brook pocket moss or Bolander's woodreed, but there would be no direct or indirect effects to their habitat under alternative 1, as no activities would occur upslope of riparian habitat.

Sensitive Plants of Rocky and Gravelly Habitat

Populations of Mono Hot Springs evening primrose and Yosemite lewisia occur within the Project area and also have a more extensive range in the Sierra Nevada. Kellogg's lewisia may occur in the same areas, the habitat is suitable. Because no salvage or road reconstruction would occur, no direct or indirect effects would be experienced by plants of rocky/gravelly habitats under the No Action alternative.

Invasive Weeds

Surveys and control of medusahead (and other weeds) would only occur during 2015, as funded by BAER, and no herbicides would be used. Eradication of medusahead is not possible under alternative 1 because at least some seeds are viable for more than a year. There would be no risk of weed introduction and spread due to project activities as the Project would not be implemented.

Cumulative Effects for Botanical Resources

Cumulative effects would not occur to native vegetation as the Project would not be implemented. Cumulative effects to FSS plants and their habitats can be variable as past, current and future actions within the Project area have occurred and may continue in the future (i.e. logging activities, road construction, introduction and spread of invasive/noxious weeds). Because there is BAER funding to conduct mechanical treatment of medusahead during 2015, initially the spread of medusahead may be checked. However, without the addition of the tool of herbicides, there may be cumulative effects if medusahead becomes intractable and prohibits the full recovery of burned native vegetation in the southern area of the Project.

3.3.4. Alternative 2 (Proposed Action)

The action alternatives have been carefully designed to avoid or minimize direct and indirect effects to FSS plant species and habitats. In addition to protective measures for streamsides, soils, hydrology, and aquatic wildlife; all of which contribute to the protection of sensitive plant habitat, project design criteria for FSS plants

have been incorporated into alternative 2. Generally they consist of surveying for sensitive plants in areas likely to have undiscovered populations, using flagging around sensitive plant occurrences to indicate areas where activities should not occur during project implementation; and ensuring that habitat for species that might occur but are not yet known to occur are protected from harm (see list of design measures in chapter 2).

Direct and Indirect Effects

Native Plant Diversity and Recovery

The total footprint of all treatments proposed under alternative 2 is 5965 acres (43%) (refer to Chapter 2). Treatments proposed on these acres could directly affect early seral plant species by killing them by driving on them, skidding on them; or parking on them; or covering them up with soil or slash; or spraying them with herbicide (but there would be a least 2-3 growing seasons before herbicide treatments commence). Severity of effects would depend on timing of treatments in relation to flowering and fruiting for each species. After the initial timber harvest, some seeds and sprouts would continue to recover the vegetation in the treatment areas; and seed would move in from adjacent areas; bringing increased species diversity and ground cover. Meanwhile, bear clover and the dominant shrub species are regaining dominance over the herbaceous flora. This alternative leaves 57% of the burn area within the fire perimeter to go through the phases of early succession unimpeded.

Sensitive Plants

Species of Forested Habitat

Short-leaved hulsea plants, should there be undiscovered populations, could be directly killed by heavy equipment used for timber harvest driving on them, especially while they are leafed out, flowering, or in the process of seed formation. Prescribed burning, especially if conducted outside of the season these plants evolved to tolerate or benefit from fire, could directly kill or impair individual plants. Herbicides would directly kill plants, but this species is not found in areas of dense bear clover, and does not occur at the lower elevations where the medusahead treatments are planned. Any short-leaved hulsea plants discovered during field surveys in 2015 would be flagged for avoidance; thus the likelihood of these direct effects occurring is low. Negative indirect effects are possible but unlikely, given consistent observations that this plant thrives after disturbance such as fire and fuels reduction treatments, and tends to grow vigorously in road corridors.

Species of Riparian and Aquatic Habitats

Fish Creek, Rock Creek, Slide Creek, and an unnamed tributary to Mammoth Pool have populations of Rawson’s flaming trumpet. Direct effects from ground disturbing activities that could harm flaming trumpet populations would not occur if all Design Criteria are followed: streams have a “no entry” zone of 100’ for heavy equipment. Possible indirect effects could be increased sedimentation and runoff into streams where flaming trumpet grows after salvage logging on burned slopes, however as the Project has been designed to minimize Cumulative Watershed Effects (see Hydrology Design Criteria in the draft EA), this is not predicted to be likely.

Species of Rocky and Gravelly Habitats

The Project has been designed to avoid direct and indirect effects to rare plants of outcrops. If all Design Criteria are followed, there would be no direct or indirect effects.

Direct and indirect Effects and Invasive Non Native Plants for All Habitat Types

Ecosystem health is threatened by the spread of invasive non-native weeds in a variety of ways. Dense infestations can reduce native biodiversity, compete with FS sensitive plant species, reduce wildlife habitat quality and quantity, modify vegetative structure and species composition, change fire and nutrient cycles,

hybridize with native species, and degrade soil structure (Bossard et al., 2000). Because the Project is designed to improve the ecosystems within the Project area by eradicating known infestations of invasive weeds and preventing the introduction and spread of new infestations or species of weeds, there would be beneficial direct and indirect effects to ecosystems as a result of alternative 2.

Invasive Weeds

With implementation of invasive weed surveys and control for BAER in 2015, control of medusahead in 2016, and thereafter with herbicides and other methods as described in alternative 2; along with the Design Criteria for weed prevention, the Project poses a low risk of weed introduction and spread. The likelihood of successfully achieving eradication of medusahead with 3-6 years of consecutive herbicide and manual treatments is high.

Cumulative Effects for Botanical Resources

Because 57% of fire area will be allowed to recover naturally, and the acres of natural recovery are well distributed across the fire area and encompass a variety of burn severities; combined with the expectation that control efforts successfully eradicate medusahead within 6 years; there is no expectation that cumulative effects would occur to early seral native plant assemblages.

Past, present, and reasonably foreseeable actions within and near the project area are detailed in Appendix E. For Mono Hot Springs evening primrose, Yosemite lewisia and other plants of rocky/gravelly habitats, ongoing motorized recreation is currently having some impacts (individual plants are sometimes killed when driven over repeatedly based on botanical monitoring over the past 10 years), but the Project would not add to these impacts as the Project has built in Design Criteria to protect rare plants within these types of habitats and has been designed to minimize damage to rocky/gravelly soils. For plants of riparian/aquatic habitats, especially Rawson's flaming trumpet, which occurs extensively in the project area, the populations within the project area are stable and expected to recover or even benefit from the Fire itself, but there are occasional instances of motorized recreation damage or cattle grazing or trampling. The Project would not add to these slight impacts because there of the 100' no entry SMZs on either side of the streams inhabited by flaming trumpet. For other sensitive plants of riparian and aquatic habitats that may occur within the project area; past, current, or future effects experienced at some level could be from the following activities: motorized recreation use, cattle grazing and trampling, roadside hazard tree removal, and fire/fuels management activities. No negative cumulative effects are expected for plants of aquatic and riparian areas because aquatic and hydrology project Design Criteria along with sensitive plant Design Criteria forestall damage to these habitats.

For invasive weeds, any activity listed in the Past, Present, and Foreseeable Future Table (Appendix E) could have spread weeds in the past and has the potential to spread weeds currently and in the future. Surveys during BAER and for other projects within the Project indicate that the area is relatively free of invasive weeds, especially considering the amount of historical and current activity occurring therein. Alternative 2 would reduce the number of infestations of invasive weeds and has been designed to minimize the likelihood of weed introduction due to Project activities, thus no negative cumulative effects for noxious weeds are expected for sensitive plant species.

In summary, no negative cumulative effects are expected for Botanical Resources as the Project has been designed to reduce or eliminate direct and indirect effects to these rare plant species and to avoid the introduction and spread of noxious weeds.

Summary of Effects

Indicators 2 and 3: Number of FS sensitive plants and Invasive Weed Infestations and Their Aerial Extent.

It is expected that after implementation of Alternative 2, the number of populations of sensitive plant species would remain the same and the aerial extent of each occurrence would remain constant or increase. The number of invasive weed infestations would decrease directly as a result of Project activities, ultimately to the point where medusahead is no longer present.

3.3.5. Alternative 3 (No Herbicides)

Direct and Indirect Effects

Native Plant Diversity and Recovery

Same as for alternative 2, except that without herbicide treatments of medusahead, native plant communities could become impaired if eradication is not achieved.

Sensitive Plants

This alternative has been designed to minimize or avoid negative effects to FSS plants and their habitat (see chapter 2). However, without the use of herbicides to control medusahead, suitable habitat for Madera leptosiphon may decline in quality over time if manual and mechanical methods fail to achieve eradication.

Invasive Weeds

With implementation of invasive weed surveys and control for BAER in 2015, control of medusahead in 2016 and thereafter without herbicides, using only manual and mechanical methods as described in the EA for alternative 3; along with the Design Criteria for weed prevention, the Project poses a Moderate risk of weed introduction and spread. Using only manual methods, hoeing, and string trimmers for medusahead control, the likelihood of successful eradication (defined as the complete absence of any plants for several consecutive years upon conclusion of treatments) of medusahead is low.

Cumulative Effects for Botanical Resources

Same as for alternative 2, except that there is a slightly greater chance of cumulative effects to early seral plant communities and sensitive plants if medusahead is not eradicated.

The effects are the same as for alternative 2; except for the greater risk that medusahead will not be eradicated and will spread throughout more FS sensitive plant habitat – especially habitat for Madera leptosiphon.

Summary of Effects

Indicators 2 and 3: Number of FS sensitive plants and Invasive Weed Infestations and Their Aerial Extent.

It is expected that after implementation of alternative 3, the number of populations of sensitive plant species would remain the same and the aerial extent of each occurrence would remain constant or increase. The number of invasive weed infestations would decrease directly as a result of project activities, however, under this alternative there is less confidence that eradication of medusahead would be achieved

3.3.6. Alternative 4 (Hazard Tree and Plantation Salvage Only)

Direct and Indirect Effects

Native Plant Diversity and Recovery

The total footprint of all treatments proposed under alternative 4 is 4333 acres or 31% of the burn area (see Chapter 2). Not only are fewer acres proposed for any type of treatment, but much more high severity burn ground is left to recover naturally under this alternative (70% of high severity ground would not be treated). Treatments proposed on most of these acres could directly affect early seral plant species by killing them by driving on them, skidding on them; or parking on them; or covering them up with soil or slash; severity of effects would depend on timing of treatments in relation to flowering and fruiting for each species. After the initial timber harvest, some seeds and sprouts would continue to recover the vegetation in the treatment areas; and seed would move in from adjacent areas; bringing increased species diversity and ground cover. This alternative leaves 69 % of the burned area to go through the phases of early succession unimpeded. Fewer acres (2300) would be treated with herbicides for site prep and reforestation under alternative 4 than under alternative 2 (3050); which would pose less risk for native plants over time due to possible dominance of sprayed sites by non-native grasses.

Sensitive Plants

This alternative has been designed to minimize or avoid negative effects to FSS plants and their habitat (see Chapter 2). Because there would be fewer acres salvage logged, there is a reduced risk of invasive weed introduction, which reduces risk to sensitive plant habitat slightly.

Invasive Weeds

The likelihood of successfully eradicating medusahead is the same as for alternative 2, as the treatments would be identical for this species. There would be a slightly reduced risk of introduction and spread of new weed infestations because fewer acres would be treated under alternative 4 than under alternative 2 (4333 vs. 5965)

Cumulative Effects for Botanical Resources

The effects are the same as for alternative 2

Summary of Effects

Indicators 2 and 3: Number of FS sensitive plants and Invasive Weed Infestations and Their Aerial Extent.

It is expected that after implementation of alternative 4, the number of populations of sensitive plant species would remain the same and the aerial extent of each occurrence would remain constant or increase. The number of invasive weed infestations would decrease directly as a result of project activities, which is a positive effect for FSS plant habitat.

3.3.7. Alternative 5 (No Secondary Entry)

Direct and Indirect Effects

Native Plant Diversity and Recovery

Similar to alternative 2, with 61% rather than 57% of all burned acres left to recover naturally.

Sensitive Plants

This alternative has been designed to minimize or avoid negative effects to FSS plants and their habitat (See chapter 2). Because there would be fewer acres salvage logged, there is a reduced risk of invasive weed introduction, which reduces risk to sensitive plant habitat slightly.

Invasive Weeds

The likelihood of successfully eradicating medusahead is the same as for alternative 2, as the treatments would be identical for this species. There would be a slightly reduced risk of introduction and spread of new weed infestations because fewer acres would be treated under alternative 5 than under alternative 2 (5453 vs. 5965).

Cumulative Effects

No substantive difference from alternative 2: with a total treatment footprint of 5453 acres (39%), this alternative leaves 61% of the burned area to recover naturally. The acres to be treated with herbicides for reforestation are slightly fewer than in alternative 2 (2900) and greater than in alternative 4 at 2300 acres. For sensitive plants and invasive weeds, cumulative effects are the same as for alternative 2.

Summary of Effects

Indicators 2 and 3: Number of FS sensitive plants and Invasive Weed Infestations and Their Aerial Extent.

It is expected that after implementation of alternative 5, the number of populations of sensitive plant species would remain the same and the aerial extent of each occurrence would remain constant or increase. The number of invasive weed infestations would decrease directly as a result of project activities, which is a positive effect for FSS plant habitat.

3.3.8. Determination

Threatened, Endangered, Candidate, and Proposed Plants

The BA/BE concluded that the Project on the Bass Lake Ranger District will not affect *Calyptridium pulchellum* because suitable habitat in foothill woodland vegetation types does not occur in the project area. No consultation with US Fish and Wildlife Service is necessary.

Alternative 1

Forest Service Sensitive Plants

The BA/BE has determined that implementation of alternative 1 (No Action) of the Project on the Bass Lake Ranger District will not affect *Camissonia sierrae ssp. alticola, Collomia rawsoniana, Cinna bolanderi,Fissidens aphelotaxifolius, Hulsea brevifolia, Lewisia disepala, Lewisia kelloggii ssp. kelloggii,* or *Peltigera gowardii* because the suite of activities proposed in alternative 2 or the other action alternatives would not occur. The BA/BE has determined that implementation of alternative 1 of the Project may affect individuals but is not likely to cause a trend to federal listing or a loss of viability to *Leptosiphon serrulatus.* This is because medusahead infestations would increase over the long-term without the weed treatments proposed in the action alternatives, potentially degrading the integrity of the native plant communities as it becomes dominant, and the area where medusahead exists is the most likely part of the project to have undiscovered populations of *Leptosiphon serrulatus*.

Alternatives 2, 3, 4, or 5

Species of Riparian and Aquatic Habitats

The BA/BE has determined that implementation of alternatives 2, 3, 4, or 5 of the Project may affect individuals but is not likely to cause a trend to federal listing or a loss of viability to *Collomia rawsoniana* and *Peltigera gowardii*. The determination of "may affect" is because although the aquatic, botany, and hydrology Project design criteria would prevent most damage that could occur to the populations along the perennial streams within the Project area, there is a possibility that a few individual plants may be subject to at least indirect effects during Project implementation. The risk is negligible to the long-term viability of any given population or to either species; and for both of these species; the populations across the district are in good health.

For other riparian or aquatic species that are not known to occur in the Project area, but may simply not have yet been discovered (*Cinna bolanderi, Fissidens aphelotaxifolius*) the BA/BE has determined that implementation of the Project may affect individuals but will not lead to a trend toward federal listing or a loss of viability. For these species, the Project design measures for aquatics, botany, and hydrology would effectively protect riparian and aquatic habitat.

Species of Rocky and Gravelly Habitats

The BA/BE has determined that implementation of alternatives 2, 3, 4, or 5 of the Project may affect individuals but is not likely to cause a trend to federal listing or a loss of viability to *Camissonia sierrae ssp. alticola*, *Lewisia disepala*, and *Lewisia kelloggii ssp. kelloggii*, because Project design criteria are in place to protect rocky/gravelly habitat; especially sites known to have FSS populations.

Species of Forested Habitats

The BA/BE has determined that implementation of alternatives 2, 3, 4, or 5 of the Project may affect FSS individuals of short-leaved hulsea and Madera leptosiphon, but is not likely to cause a trend to federal listing or a loss of viability**.** The reason for the "may effect" determination is that if as-yet undiscovered FSS occurrences are present in the Project area, they could exist in areas of salvage harvest, fuels clean-up, reforestation activities, and DFPZs, where identification of the plants prior to activities is possible but not guaranteed. For invasive weed treatments, the Forest Botanist would be involved in implementation, raising the odds that any previously unknown *Leptosiphon serrulatus* populations would be noticed and protected.

Other FSS plants on the SNF list do not have habitat within the project area, and therefore will not be affected by the project (see BA/BE, Appendix A for rationale).

3.4. Economics

3.4.1. Background and Affected Environment

The focus of the economics analysis is to address the effectiveness of each alternative meeting the purpose and need for the Project related to recovery of burned timber and forest products in a cost-efficient manner that is beneficial to local communities and forest management. The direct and indirect effects are summarized from the Economic Analysis Report (Simmons 2015) for the Project.

An economic analysis can be helpful in selecting an alternative by showing comparative costs and\or revenues between alternatives. However, economics will not be a deciding factor for selecting the alternative for the Project. Instead, alternative selection will be based on the alternative that best accomplishes the purpose and need of the project. This economic analysis, will give the public an approximate comparison of costs between the proposed actions and the no action alternative.

The Forest Vegetation Simulator (FVS) was used to determine the harvest volumes and tree removals produced from each alternative. These values were used in the cost efficiency analysis to determine the value of wood products extracted from the forest (stumpage values) and arriving at the mill. The timing of product extraction is an important factor when dealing with fire salvage timber. Product deterioration leading to volume loss occurs usually a year after the wildfire event. Also, the reduction in product quality from agents such as blue stain begins to affect product value. Prompt product removal is essential in recovering the greatest value of forest products. Harvest values (stumpage) were determined from current production costs and wood values. The size of harvest material and its quality effects harvest values.

The second part of the cost efficiency analysis is the cost of other treatments to accomplish recovery and reforestation work. This work includes activities such as site preparation, fuels reduction work, and release treatments. In most cases, these costs exceed the stumpage values and require additional appropriated funds.

The socioeconomic benefits related to product removal and project treatments can be far reaching. Many jobs are maintained both directly and indirectly when recovery and reforestation work is accomplished after a wildfire incident.

Inputs (appropriated funds and standing timber value), outputs (harvest volume), prices, and costs are estimated quantities. These estimates are the result of model outputs, previous contract prices, and previous costs. Uncertainty exists about these quantities due to congressional funding and market conditions.

Providing for Local Communities

Currently (2014) the SNF is providing timber for three remaining sawmills, Sierra Forest Products (SFP), Terra Bella, CA, and Sierra Pacific Industries (SPI), at Chinese Camp and Standard, CA. The SFP mill is the last remaining sawmill in California south of Yosemite National Park. Lumber manufacturing waste products are utilized in several other markets including landscaping. SFP is a qualifying small business and SPI is a large business in computations for Small Business Administration market share monitoring purposes. SFP is highly dependent upon raw material from Federal Lands. The Sierra and Sequoia National Forests have traditionally relied upon the SFP milling infrastructure to process and give value to excess tree inventories in the woods when considering fuels and fire management, forest health maintenance, and wildlife habitat restoration treatments. In recent years, SPI has been successful in securing timber sale contracts on the Bass Lake Ranger District. In order to implement the types of projects considered in this analysis, an economically viable infrastructure is necessary now and into the future. Maintenance of such an infrastructure is voiced as a concern by some segments of the public.

The current lumber market has improved in the last few years from the low in 2009, when sawtimber value dropped to historic lows. This current lumber market is the result of increased housing starts across the nation over the last few years. The increased demand for wood products leaves local sawmills in dire need of forest products to keep them open. If these mills close, the ability to utilize forest products in the future and offset treatment costs would be lost. The Project would cost more money than it could generate from the forest products removed. Therefore, additional appropriated dollars would need to be requested to complete any of the action alternatives. Treatments prescribed were developed to promote long-term ecological recovery and preserve and develop habitat, and to provide funds from the value of forest products for reforestation.

Whenever you have a project that puts people to work and provides a product to the free market, there are societal benefits derived. Woods workers, truck drivers, and mill workers are directly employed and the taxes they pay benefit both Federal and State Government. Yield taxes are collected from Purchasers upon cutting sawtimber and are paid to the State. Processed materials from mills eventually reach retail stores and provide jobs for retail workers and income and sales tax to Federal and State Government. These societal benefits are a by-product of the prescribed treatments designed to meet the purpose and need of this project. When greater amounts of forest products are removed from a project, more societal benefits are realized.

3.4.1.1. Indicators

Three indicators were used to assess the cost efficiency and socioeconomics of the No Action alternative and the four action alternatives.

Indicator 1: Revenue of harvest volume

This indicator is the estimated delivered value of products (stumpage) to the mill facility. This indicator was selected because it relates to the purpose and need of recovering economic value of burned timber and forest products in a cost-efficient manner. It takes into account the following cost centers: logging stump to truck, slash treatment, erosion control, road maintenance, temp road, log haul, biomass treatment, and brush disposal deposits.

Indicator 2: Cost of other recovery and reforestation work

This indicator is the post-harvest costs necessary to complete the recovery and reforestation needs for the Project not related to product removal. This indicator was selected because it relates to the purpose and need of providing cost effective treatments that are beneficial to local communities and forest management. It takes into account the following cost centers: mechanical fuel treatment, post-harvest treatment, burn treatment, reforestation (site preparation, planting, and release treatment), timber sale preparation and administration, post-sale contract preparation and administration, and the Project NEPA planning.

Indicator 3: Employment benefit (socioeconomic)

This indicator estimates the direct and indirect employment benefits of product removal to milling facilities and post-harvest activities. This indicator was selected because it relates to the purpose and need of recovering economic value of burned timber and forest products in a cost-efficient manner beneficial to local communities and forest management. There is a relationship between employment and harvest that can be quantified. Each million board feet of harvest supports 6 – 26 year around direct and indirect jobs (*Corn and Alexander 2012; Grinspoon and Phillips, 2011*). A conservative estimate would be 13.1 jobs per million board feet harvested. Post-harvest activities support additional direct and indirect employment. Employment for post-harvest activities creates approximately 1.4 indirect jobs for each full time field job.

3.4.2. Environmental Consequences

This section analyzes the effects (environmental consequences) from the Project on three economic indicators. The direct and indirect effects on these economic indicators will be analyzed, together with the cumulative effects of other activities that are interrelated or interdependent with that action. These actions will be added to the environmental baseline. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area.

Direct and indirect effects for indicator 1 are measured by the actual value and volume of the removed timber product. Direct and indirect effects for indicator 2 are measured by the costs associated with the reforestation and those other recovery activities that are not associated with stumpage value removed. Direct and indirect effects for indictor 3 are measured by the direct and indirect employment of implementing proposed activities. Economic cumulative effects measure the contribution of the Project, based on the identified indicators, on the local economy and associated milling infrastructure needed to manage Forests and consume by products of restoration and fuels treatments.

3.4.3. Alternative 1 (No Action)

No new actions and no direct change in the local economy would occur as a result of this alternative. Current and foreseeable projects would continue to provide economic benefits. The alternative identifies the baseline for action alternatives and the potential long-term impacts from not implementing the project.

Direct and Indirect Effects

Indicator 1 – Revenue of Harvest Volume

The No Action alternative implements no proposed activities and would not generate revenue or volume from the recovery of fire-killed trees. The opportunity to harvest approximately 31 million board feet of timber product with a delivered milling facility value of approximately $270,000 would be lost. The need of recovering economic value of burned timber and forest products for the benefit to local communities and forest management would not occur.

Indicator 2 – Cost of other recovery and reforestation work

The No Action alternative would forego the recovery and reforestation work that is identified in the purpose and need. These treatments require the value from product removal and appropriated funds to pay for their implementation. Foregoing recovery and reforestation treatments would save taxpayers approximately $4,770,000 of appropriated funding needed to implement these activities.

Indicator 3 - Employment benefit

The No Action alternative would provide limited employment benefit. The only full time jobs created would be the employment of Forest Service personnel involved in the planning of this project. Approximately 4.2 full time jobs would be created in the community, with a financial benefit of approximately $345,000.

Cumulative Effects

Economic cumulative effects are those that effect the local economy and milling infrastructure needed to manage Forests and consume by products of restoration and fuels treatments. A viable milling infrastructure is maintained only when forest products are made available for processing by mills. The local forest management implementation workforce can only be maintained with product removal and post-harvest treatments. The SFP mill in Terra Bella, located 140 miles (8 hour round trip for logging truck) from the Project area, provides infrastructure for utilization of sawlog material. The next closest mill is the SPI mill, near Sonora, California, 120 miles (more than 7 hour round trip) from the Project area. The SFP mill is highly dependent of material from the SNF. The loss of local mill infrastructure would raise transportation costs from approximately $179 dollars per thousand board feet of timber to approximately $220 dollars per thousand board feet. Transportation costs to milling infrastructure may make most or all projects that remove forest products unprofitable.

The No Action alternative would not contribute revenue from the removal of forest products from this Project. Timber sales currently operating on the SNF (identified in Appendix E, past, present, and reasonably foreseeable projects), including hazard tree removal from an existing decision (Mile High CE) within the Project area, would continue to provide material for milling infrastructure. Post sale treatments from current projects would continue to use appropriated funds from tax payers to implement the treatments. Jobs would continue to be provided by the implementation of current timber sales, post-sale treatments, use of the cattle grazing allotment found within the project area, and the Forest Service planning of this project. The loss of fire recovery volume could result in the potential loss of milling infrastructure. If milling infrastructure is lost, an increase in the cost of future restoration and fuels reduction projects would occur. The lack of active management represented by the no action alternative could cumulatively result in additional cost in achieving Forest Service goals.

3.4.4. Alternative 2 (Proposed Action)

Direct, indirect, and cumulative effects for alternative 2 are presented in this section to facilitate the comparison of the alternatives.

Direct and Indirect Effects

Indicator 1 – Revenue of Harvest Volume

Alternative 2 would recover the volume and value of fire-killed timber within the Project area. This alternative would harvest approximately 31.5 million board feet of timber product with a delivered milling facility value of approximately $269,000. Alternative 2 would meet the need of recovering the economic value of burned timber and forest products in a cost-efficient manner beneficial to local communities and forest management.

Indicator 2 – Cost of other recovery and reforestation work

Alternative 2 would implement the proposed recovery and reforestation work that is identified for the Project. These treatments would use the value from product removal and appropriated funds to pay for their implementation. Taxpayers would spend approximately $4,770,000 of appropriated funding to complete the recovery and reforestation work in the proposed action.

Indicator 3 - Employment benefit

Alternative 2 would provide substantial employment benefits as compared to alternative 1. The recovery of 31.5 million board feet of timber products would create approximately 413 direct and indirect full time jobs. The other resource recovery and reforestation work would create approximately 151 full time jobs. Employee related income from the 564 jobs created would be approximately $22.5 million.

Cumulative Effects

The cumulative effects of alternative 2 along with other reasonably foreseeable actions (Appendix E) provide timber products to the local economy and maintains mill infrastructure. This available timber product value, along with appropriated funds, would help finance post-harvest activities including reforestation. The cumulative effect of maintaining mill infrastructure is to continue to have the SFP mill available to process timber products from the SNF. Numerous jobs would be created to help the local forest management workforce. There would be an increased burden to tax payers to implement the post-harvest treatments.

Alternative 2, along with other reasonably foreseeable actions, is more likely to maintain mill infrastructure and provide local jobs than the no action alternative.

3.4.5. Alternative 3 (No Herbicide)

Direct and Indirect Effects

Indicator 1 – Revenue of Harvest Volume

Alternative 3 would recover the volume and value of fire-killed timber within the Project area at the same amount as Alternative 2. Alternative 3 would harvest approximately 31.5 million board feet of timber product with a delivered milling facility value of approximately $269,000. Alternative 3 would meet the need of recovering the economic value of burned timber and forest products in a cost-efficient manner beneficial to local communities and forest management.

Indicator 2 – Cost of other recovery and reforestation work

Alternative 3 would implement the recovery and reforestation work at a cost of approximately $10,245,514; this is more than alternative 2 by approximately $5,203,335. These treatments would use the value from product removal and appropriated funds to pay for their implementation. Taxpayers would spend approximately $9,975,581 of appropriated funding to complete the recovery and reforestation work in alternative 4. The reason for the increase cost is due to the increase in release acres of approximately 77% and an increase in cost per acre of 51%. In addition, the increase number of acres that might have to be replanted is approximately 56%, again increasing the cost per acre by 10%.

Indicator 3 - Employment benefit

Alternative 3 would provide substantial employment benefits as compared to alternative 1. The recovery of 31.5 million board feet of timber products would create approximately 413 direct and indirect full time jobs. The other recovery and reforestation work would create approximately 425 full time jobs. Employee related income from the 839 jobs created would be approximately $33.5 million, an increase of direct and indirect full time jobs compared to alternative 2. The reason for this employment upturn is the increase in the number of *release acres* of about 77%, making the replanting number increase approximately 56%. The amount of recovery and reforestation work has a direct relationship with direct and indirect full time job employment.

Cumulative Effects

Cumulative effects for alternative 3 are same as alternative 2 in respect to the volume and value of products removed. The differences in alternative 3 from alternative 2 are the cost of post-harvest implementation and the jobs provided to the local economy. Less appropriated funding would be necessary to fund post-harvest activities and more jobs would be created as compared to the proposed action. Alternative 3 would maintain mill infrastructure similar to the proposed action because the harvest volume is the same between alternatives.

3.4.6. Alternative 4 (Hazard Tree and Plantation Salvage Only)

Direct and Indirect Effects

Indicator 1 – Revenue of Harvest Volume

Alternative 4 would recover the volume and value of fire-killed timber within the Project area at approximately 10,019 million board feet (MBF) of timber product with a delivered milling facility value of approximately $96,466; this $173,467 lower than alternative 2. The difference in timber value is related to the lack of harvesting within the first or secondary entry units.

Indicator 2 – Cost of other recovery and reforestation work

Alternative 4 would implement the recovery and reforestation work at a cost of approximately $3,770,106; this is less than alternative 2 by approximately $1,098,607. These treatments would use the value from product removal and appropriated funds to pay for their implementation. Taxpayers would spend approximately $789,605 of appropriated funding to complete the recovery and reforestation work in alternative 4. The reason is, due to harvesting fewer acres, there are fewer acres to do recovery and reforestation work on.

Indicator 3 - Employment benefit

Similar to the other action alternatives, alternative 4 would provide substantial employment benefits. The recovery of 10 million board feet of timber products would create approximately 131 direct and indirect full time jobs. The remaining recovery and reforestation work would create approximately 95 full time jobs. Employee related income from the 227 jobs created would be approximately $9 million, a decrease of direct and indirect full time jobs compared to alternative 2. The reason is, due to harvesting fewer acres, there are fewer

acres to do recovery and reforestation work on. Amount harvested and the amount of recovery and reforestation work has a direct relationship with direct and indirect full time job employment.

Cumulative Effects

Cumulative effects for alternative 4 are different when compared to alternative 2. There is less timber products (volume and value) removed in alternative 4. The lower harvest volume and stumpage value would provide fewer funds to complete the other recovery and reforestation activities. Alternative 4 creates fewer product removal based jobs and fewer post-harvest treatment jobs when compared to alternative 2. Less appropriated funding would be necessary to fund post-harvest activities as compared to alternative 2. Alternative 4 would help maintain mill infrastructure, but not at the level of the proposed action because the harvest volume is lower.

3.4.7. Alternative 5 (No Secondary Entry)

Direct and Indirect Effects

Indicator 1 – Revenue of Harvest Volume

Alternative 5 would recover the volume and value of fire-killed timber within the Project area at a lower amount than alternative 2. Alternative 5 would harvest approximately 27.0million board feet of timber product with a delivered milling facility value of approximately $230,585. This amount is approximately 4.5 million board feet and $39,348 of timber value less than alternative 2.

Indicator 2 – Cost of other recovery and reforestation work

Alternative 5 would implement the recovery and reforestation work that is identified in the purpose and need at a cost less than alternative 2 by approximately $5,441,557. These treatments would use the value from product removal and appropriated funds to pay for their implementation. Taxpayers would spend approximately $4,570,000 of appropriated funding to complete the recovery and reforestation work in alternative 5.

Indicator 3 - Employment benefit

As with the other action alternatives, alternative 5 would provide substantial employment benefits. The recovery of 27.0 million board feet of timber products would create approximately 413 direct and indirect full time jobs. The other recovery and reforestation work would create approximately 416 full time jobs. Employee related income from the 829 jobs created would be approximately $33.2 million, a decrease of $365,324 thousand compared to alternative 2.

Cumulative Effects

Cumulative effects for alternative 5 are different when compared to Alternative 2. There is less timber products (volume and value) removed in alternative 5. The lower harvest volume and stumpage value would provide fewer funds to complete the other recovery and reforestation activities. Alternative 5 creates fewer post-harvest treatment jobs when compared to the proposed action. Less appropriated funding would be necessary to fund post-harvest activities as compared to the proposed action. Alternative 5 would help maintain mill infrastructure, but not at the level of the proposed action because the harvest volume is lower

Table 16 compares the harvest volume, harvest revenue, post-harvest cost, and the number of full time jobs created of the no action and the three action alternatives.

Table 16. Harvest Volume, Harvest Revenue, Post Harvest Costs, and Full Time Jobs Created

Alternatives	Harvest Volume MBF[17]	Timber Value	Other recovery and harvest Cost	Cost to Taxpayers	Full Time Jobs Created
Alternative 1	0	$0	$0	$0	4.2
Alternative 2	31.5	$269,933	$5,042,179	$4,772,246	564.1
Alternative 3	31.5	$269,933	$10,245,514	$9,975,581	838.7
Alternative 4	10.0	$96,466	$3,770,103	$3,673,639	226.6
Alternative 5	27.0	$257,644	$4,803,957	$4,546,314	442.9

3.5. Fire and Fuels

3.5.1. Background and Affected Environment

The focus of the fire and fuels analysis is to address the effectiveness of the alternative 2 in meeting the needs for the Project related to reducing the fuel loading from fire and bug killed trees, reducing fire intensity of future fires, improving effectiveness of fire suppression operations and firefighter, public and employee safety within the Project area.

3.5.1.1 Indicators

The effects of the alternatives were evaluated using the indicators discussed below. The indicators were selected as being the most meaningful and relevant given available data to quantifying the effects on the landscape for protecting the values at risk and for evaluating fire suppression effectiveness and wildfire reburn potential. Further definition of the indicators and how they apply to the purpose and need, and desired condition of the Project can be found in the Cumulative Effects section.

Indicator 1: Fuel Loading

Surface fuel loading is the weight of the combustible material available to burn. The fuel profile is a combination of 1) fuel loading in tons per acre, 2) arrangement of the fuels (compacted or loosely arranged) both live and dead and 3) the continuity of the fuel; both horizontally (surface fuels) and vertically (ladder fuels); these three components affect fire behavior, fire intensity and rate of spread. Fuel loading directly affects the resistance to control and firefighter line production rates. Optimal fuel loading for dry site ponderosa pine is 5-20 tons per acre. For subalpine/fir types – optimal is 5-30 tons per acre (Brown and others 2003). The baseline condition for natural range of variation for this analysis will be a fuel loading range from 5-30 tons per acre.

Coarse woody debris (CWD) and decomposition time contributes to the overall fuel loading. Wagener and Offord (1972) found is an extensive study of the decomposition of logging slash that mixed conifer forests in the Sierra Nevada would require an estimated 30 years or more for the fire hazard to shift from extreme to low; and that about 1/3 of the original volume of wood is still undecayed after 30 years. Brown and others (2003) found that generally high to extreme fire hazard potential exists when downed CWD exceeds 30-40 tons per acre, and suggest the range on warm dry sites such as ponderosa pine that 5-20 tons per acre is optimal; with 10-30 tons as optimal for sub-alpine sites. This amount of surface fuel loading for yellow pine/mixed conifer (YPMC) is in line with information provided by Safford (2013) on natural range of variation for YPMC and by Peterson and others (2009) for forest development and fire hazards in a recovering forest. The contribution of surface fuels and fire hazard of the CWD will present a long term problem for fire managers.

[17] Volume in thousands of board feet

Indicator 2: Flame Length

Flame lengths (the average length of a flame at a given point – expressed in feet) can be used as an observable measure of fireline intensity (the amount of heat released in BTU's). Fireline intensity is in direct relation to flame length, the longer the flame length the higher the fire line intensity. Although fires can be dangerous at any intensity, low flames lengths are easier to extinguish than high flames lengths. Optimal flame lengths for protecting the public and firefighters is < 4 foot along strategic roads, public recreation areas and administrative sites; and <8 foot flame lengths outside of strategic areas (Andrews and others 2011). The baseline condition used for this analysis will be 0 to 8 feet flame lengths.

Fire behavior is the manner in which a fire reacts to the influences of fuel, weather, and topography. Fire behavior is typically modeled at the flaming front of the fire and described most simply in terms of fireline intensity (flame length) and in rate of forward spread. The implications of observed or expected fire behavior are important components of suppression strategies and tactics, particularly in terms of the difficulty of control and effectiveness of various suppression resources. The Hauling Chart in the figure below is an excellent tool for measuring the safety and potential effectiveness of various fireline resources given a visual assessment of active flame length. It was so named because it infers the relative intensity of the fire behavior to trigger points where hauling various resources to or away from an incident should be considered.

Table 17. Hauling Chart Description Fire Suppression Interpretations of Flame Length and Fireline Intensity

Flame Length (feet)	Fireline Intensity (BTU/ft/s)	Interpretation
<4	<100	Fire can generally be attacked at the head or flanks by firefighters using handtools. Handlines should be successfully held.
4 – 8	100 – 500	Fires are too intense for direct attack on the head by firefighters using handtools. Handline cannot be relied on to hold fire. Equipment such as dozers, fire engines, and retardant aircraft can be effective.
8 – 11	500 – 1,000	Fires may present serious control problems such as torching, crowing, and spotting. Control efforts at the head would probably be ineffective.
>11	>1,000	Crowning, spotting, and major fire runs are probable. Control efforts at the head of fire are ineffective.

Source: Rothermel 1983

Understanding why this chart is referred to as the "Hauling Chart" will help explain its importance to firefighter and public safety in the face of a wildfire. When flame lengths are less than 4 feet, a fire crew using just shovels, rakes, axes, and chain saws can be hauled to the fire and their suppression actions would be generally successful. With flame lengths of 4 to 8 feet, heavy equipment such as dozers along with aviation resources needs to be hauled to the fire for suppression actions. When flame lengths are over 8 feet, all firefighting equipment and personnel are in harm's way and need to be hauled away from the fire to a safety area. In essence it is futile attempt a direct frontal attack on a wildfire when the flame lengths are greater than 8 feet regardless of how much or what type of equipment is available. Fires that have flame lengths less than 4 feet require fewer suppression resources, are the easiest to control, and pose the least amount of danger to wildland firefighters.

Analysis Methodology

Modeling for this analysis assumes that the condition (fuel model and environmental parameters) for each simulation unit is homogenous. Fire weather used was the actual weather during the Aspen Fire in July and August of 2013 which was very similar to the French Fire.

The surface fuel modeling over time includes the potential for post fire insect (Mtn. pine beetle) induced mortality. Behave and FVS modeling data was utilized for this report. Figure 5shows the flow diagram for the fire behavior modeling used for the analysis. There were some fuel models that were adjusted after field visits to the Aspen and French Fire area during the Mile High Hazard Sale and on the ground knowledge of the French Fire for the increased amounts of bear clover and other shrub fuels and more dense, large diameter timber overall that is present in the Project area.

Modeling shows near term information and similar information projected 40 years into the future (2054). A forty year interval was selected because the longevity of forest fuels and the associated flammability if the effects of proposed treatments of the alternatives designed to meet the purpose and need of the Project using the indicators of fuel loading and flame length.

The fire behavior analysis is for a potential future fire in the Project boundary for those units proposed for treatments so as to compare the effectiveness of the proposed alternatives vs. the No Action alternative. Analysis of the No Action alternative may be used as a surrogate for the entire 13,835 acre landscape for addressing the potential and severity of future fires.

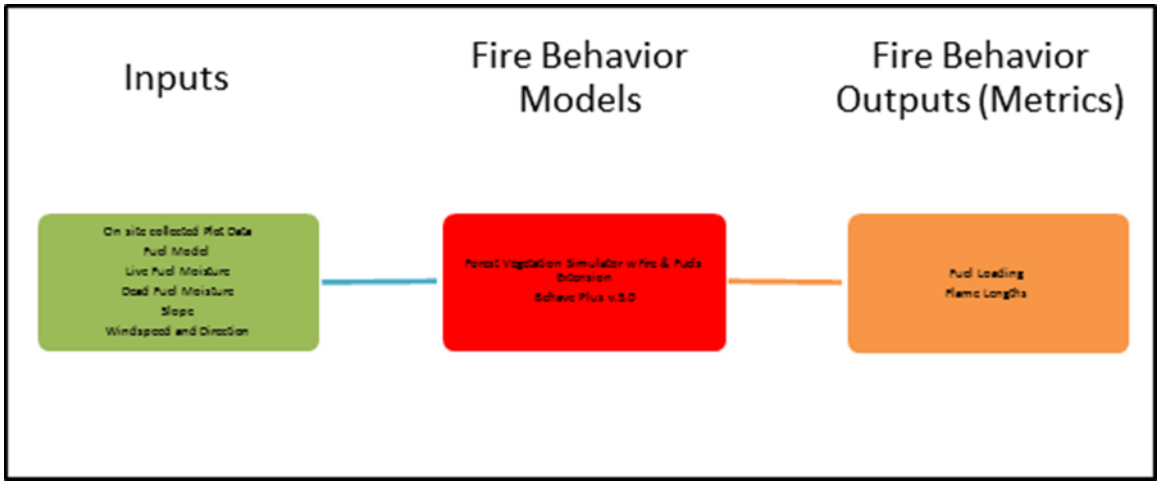


Figure 5. Flow Diagram of Fire Behavior Modeling used for the analysis.

3.5.2. Existing Condition

Fuels

Changes in stand structure after wildfire are the result of fire-caused tree mortality and subsequent changes in the size and distribution of overstory and understory vegetation. Varying levels of tree mortality with different levels of fire severity can affect the structure and composition of the surface woody fuel loading. This surface fuel is defined as fuel loading changes in fine woody debris (FWD, woody biomass less than 3 inches diameter) and in large woody debris (CWD, woody biomass greater than 3 inches diameter) immediately post-fire as well as overtime as fire killed trees collapse and increase surface fuel loading.

Estimates and modeling of current surface fuel loading and changes over time are based on measured dead and down fuel inventory plot data using the Brown Planer Intercept method collected pre and post fire as part of fire effects data gathering. Also used were representative fuel photo series (Maxwell and Ward 1980) taken from stand exams (pre and post fire). Current and future predicted surface fuel beds in the project area are a mix of burn areas as well as forest litter, duff and down logs, branches, and twigs; as well as accumulation over time from fire and subsequent insect killed snags.

Fire behavior fuel models are used to describe and predict surface fire spread and fire intensity changes reflected as flame length over time on this landscape based on different levels of fuel loading. It is the proposed action restoration treatments versus untreated areas that will characterize the transition from fire or bug killed snags to surface fuel over time. Snags currently range from severely affected trees (no limbs and/or needles present to dead trees that have full crowns intact but dead (Figures below).

Figure 6. Severe mortality with no crowns present is represented in the left photo. The right photo shows severe mortality with crowns intact.

Plant regrowth (reference Botanical Resources Report, in Project Record) along with increases in surface fuel loading can influence fire intensity, reburn potential and residence time of fire and spotting potential as well as hindrance to fire suppression efforts (resistance to control). The abundance and composition depend on seed source, scarification of soils and ability of site to reseed conifers.

The Project area is diverse in characterizations of fuel loading and existing conditions due to the patchiness and complexity of the wildfire effects. Post fire surface fuel loading range from 0 – 10 tons per acre immediately post fire with the exception being the area along the Southern California Edison power line right of way which is currently at over 200+ tons/acre due to tree felling activities that occurred to replace damaged power lines (data available at district office); the mosaic of burned versus unburned, high severity patches to very low/unburned patches; make the generalizations of the affected environment complex.

Fuel Models

Fire behavior fuel models are a set of fuelbed inputs used to predict surface fire intensity and are described in terms of both expected fire behavior and vegetation. A fuel model is chosen by the primary carrier of the fire (e.g., grass, brush, timber litter, slash) and its fuel characteristics (e.g., fuel loading, surface area to volume ratio, fuel depth). Fuel model parameters are a combination of surface fuel loading, the distribution of the fuel among the fuel particle size classes, live and dead vegetation and the moisture content of the live and dead fuels. In this project, Anderson's (1982) 13 standard fuel models and the landscape changes over time are outputs of the fire modeling.

Fire behavior characteristics are directly related to fire behavior fuel models, but vary with fuel moisture and wind. Fire behavior fuel modeling provides managers a way to differentiate fire behavior and intensity (flame length) depending on fuel model group: grass brush, timber litter or slash (Anderson 1982).

Fuel Models (FM) and Descriptions

FM 2 Fire spread is primarily through the fine herbaceous fuels or bear clover shrub fuels, either curing or dead. These are surface fires where the herbaceous material, in addition to litter and dead down stemwood from the open shrub or timber overstory, contributes to the fire intensity.

FM 5 Fire is generally carried in the surface fuels that are made up of litter cast by the shrubs and the grasses or forbs in the understory. The fires are generally not very intense because surface fuel loads are light, the shrubs are young with little dead material, and the foliage contains little volatile material. Usually shrubs are short and almost totally cover the area.

FM 6 Fires carry through the shrub layer where the foliage is more flammable than fuel model 5, but this requires moderate winds, greater than 8 mi/hr at midflame height. Fire will drop to the ground at low wind speeds or at openings in the stand.

FM 8 Slow-burning ground fires with low flame lengths are generally the case, although the fire may encounter an occasional "jackpot" or heavy fuel concentration that can flare up. Only under severe weather conditions involving high temperatures, low humidity's, and high winds do the fuels pose fire hazards.

FM 9 Fires run through the surface litter faster than model 8 and have longer flame height. Long-needle conifer stands like Ponderosa, and Jeffery natural stands and plantations are grouped in this model. Concentrations of dead-down woody material will contribute to possible torching out of trees, spotting, and crowning.

FM 10 The fires burn in the surface and ground fuels with greater fire intensity than the other timber litter models. Dead-down fuels include greater quantities of 3-inch or larger limb wood resulting from over maturity or natural events that create a large load of dead material on the forest floor.

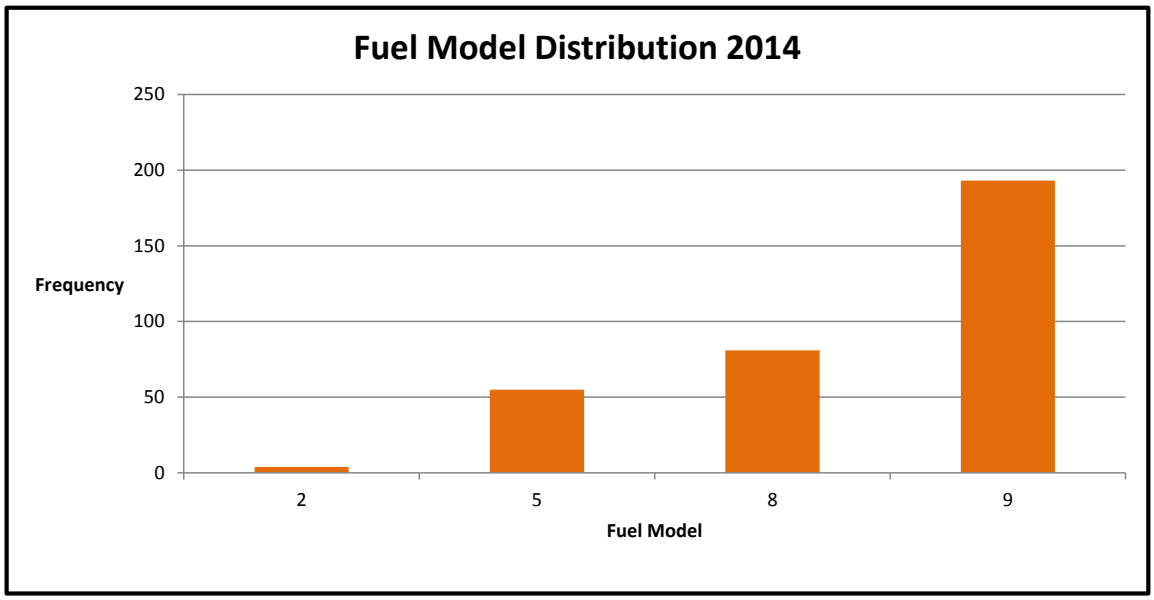
FM 11 Fires are fairly active in the slash and herbaceous material intermixed with the slash. The spacing of the rather light fuel load, shading from overstory, or the aging of the fine fuels can contribute to limiting the fire potential.

FM 12 Rapidly spreading fires with high intensities capable of generating firebrands can occur. When fire starts, it is generally sustained until a fuel break or change in fuels is encountered.

FM 13 Fire is generally carried across the area by a continuous layer of slash. Large quantities of material larger than 3 inches are present. Fires spread quickly through the fine fuels and intensity builds up more slowly as the large fuels start burning. Active flaming is sustained for long periods and a wide variety of firebrands can be generated. These contribute to spotting problems as the weather conditions become more severe.

The table 18, below shows the distribution of fuel models from plot data (represented by frequency) taken in the Project area immediately post-fire.

Table 18. Fire Behavior Fuel Models as an indicator of fuel loading post fire 2014, for proposed treatment areas only.



Flame Lengths

Surface flame lengths are a measure of how intense a fire may become and a proxy for ease of fire suppression (resistance to control). The implications of observed or expected fire behavior are important components of suppression strategies and tactics, particularly in terms of the difficulty of control and effectiveness of various suppression resources.

Heavy surface fuel loads generally contribute to longer flame lengths due to length of time the fuels stay burning (residence time). Wind speeds also contribute to flame lengths; high winds generally increase flame lengths and the rate of fire spread. Since surface fuel loading is a combination of live understory vegetation and dead woody debris fuel loading, predicted flame lengths change as fuel loading increases coupled with increased winds can have dramatic effects on fire behavior in the Project area. Using the fuel models from the above table and both general nighttime winds and daytime up-canyon winds; flame lengths across the Project area will be highly variable due to changes in vegetation and fuel loading as well as day and night time wind fluctuation. Table 19, below, shows the wide range of predicted fire behavior based on wind speeds and fuel model.

Table 19. Flame Length (ft.) variations by wind speeds and by fuel model for existing conditions.

	10 mph wind (night)	25 mph wind (day)
FM 2	5.1	31.9
FM 5	5.4	22.7
FM8	0.9	2.3
FM 9	2.4	12.7
FM 10	4.7	18.9
FM 11	3.1	9.5
FM 12	7.5	22.4
FM 13	9.8	29.4

3.5.3. Environmental Consequences

3.5.3.1. Alternative 1 – (No Action)

The analysis of the No Action alternative provides reviewers a baseline to compare the magnitude of environmental effects of the action alternatives and the potential long-term impacts from not implementing the Project. Under the No Action alternative, salvage harvest, hazard tree removal, DFPZ creation and maintenance, SCE power line fuels treatment, invasive weed treatment, site preparation, and tree planting in specified treatment areas would not occur.

Current management plans would continue to guide management of the Project area, for example recreation, grazing, and fire suppression would continue under existing decisions and authorities. In general, existing conditions in the Project area would be driven by vegetation response to fire effects, amount of precipitation, and insect attack. Fire-affected trees would be subject to decay and breakage. High and moderate severity areas most affected by the fire would see brush and oaks sprout and brush seed scarified by heat would germinate in the spring of 2015. Surviving conifers adjacent to high and moderate severity area would cast seed. Areas of low and very low severity still dominated by conifers would see increased growth.

Direct Effects

There are no treatments under the No Action alternative and therefore, no direct effects.

Indirect Effects

Indicator 1: Fuel Loading

Alternative 1 results in increasing levels of fuel loading from fire and bug killed trees over the extent of the Project area. High fuel loading results in increased costs for firefighting and jeopardizes firefighters' health and safety. Fires in areas with high fuel loads cost more to fight as these areas have increased resistance to fire suppression efforts since there is a larger fuel source to feed the fire. Fires that are harder to control and burn hotter and longer in one location can place firefighters' lives at risk due to potential snag fall. Elevated surface

fuels can constitute a large risk to the succeeding stand and present a challenge and safety risk to fire crews in any subsequent burns of these areas (Ritchie and others 2013). If there are extreme fire conditions along roads and DFPZs the firefighters lose the opportunity to keep the system roads and DFPZ pre-attack areas as strategic locations for firefighters to begin to control the fire.

Since 2000 there have been 57 fire fighter fatalities due to snags falling during wildfires (http://www.wildfirelessons.net/irdb). Not treating the dead trees (both fire killed and subsequent post-fire bug-killed) along system roads within the burn area places fire fighters and the public lives at risk. The trees along these roads leading into the upper district and to trails into Shuteye Ridge and Mammoth Pools remain a threat for 10 to 20 years (Brown and others 2003). This threat will exist under no action alternative. The snag fall rates increase over time for the first decade and typically pine snags fall within the first 5-15 years (Keyser and others 2008). It is during this time that the risk to agency personnel, the public and firefighters are at the greatest risk.

Fuel loading immediately after a wildfire ranges from unburned in some portions of the fire area with a light fuel loading to heavy fuel loading in burned areas of the fire. Standing snags may retain a substantial amount of biomass that contributes to surface fuels over time as these snags fall. Although large wood is not included in surface fire spread models, it can contribute to fire behavior and fire spread by acting as a source of embers, both directly by lofting from burning snags and indirectly through torching of trees preheated by burning of heavy fuels on the forest floor (Ritchie and others 2013, B. Stalter personal observation as fire and prescribed fire manager). Fires that burn long and are difficult to control, are substantially influenced by loading, size and decay state of large woody fuel (Brown and others 2003). This is true for wildfires (B. Stalter, personal observations) where snags and heavy down woody debris are a source of spot fires that increase the resistance to control and where high winds occur. The sustained burning of persistent fires can be fanned into fast moving, dangerous fires.

Additionally Hoffman and others (2012) found that surface fuel loading increases from bug killed trees was above the recommended ranges for dry coniferous forests. Fire tends to weaken trees and lead to an increase in bug killed trees as trees have reduced defenses to insect attack. Hoffman and others (2012) found that surface fuel loading averaged 2.5 times higher in bug mortality areas and that most trees fell within three years. A majority of the trees were on the ground within 5-15 years (a detailed description of the potential for bug induced mortality is presented in the Silviculture section of the EA).

The effect of strong Mono winds in the area, which increase the snag fall rate, would cause fuel loads from these dead trees to accumulate up to high levels at faster than most of the published literature states. Areas that are sheltered from these winds such as drainage bottoms on the south aspects would likely be spared these unique effects. High tree falling rates were observed over time on the Rock Creek Fire from 2002 and on the Rock Fire from 2007 which had many of the fire and insect killed snags blown over in a Northeast to South – Southwest pattern (B. Stalter 2011). Large woody fuels would accumulate through fall down driving fuel loading to reach over 200 tons per acre in places where stand replacing severe fire did not consume the tree crowns. Fuel loading over time under the no action alternative for moderate and high severity burned areas is predicted to start at very low tons per acre values initially but reach over 180 tons per acre in 50 years (Figure 7 below). In low to moderate severity areas initial fuel loading will start out at a low ton per acre but is predicted to reach over 200 tons per acre in 50 years. Due to all of these fuel loading factors, the continuity of fuel will provide for difficult suppression in the future.

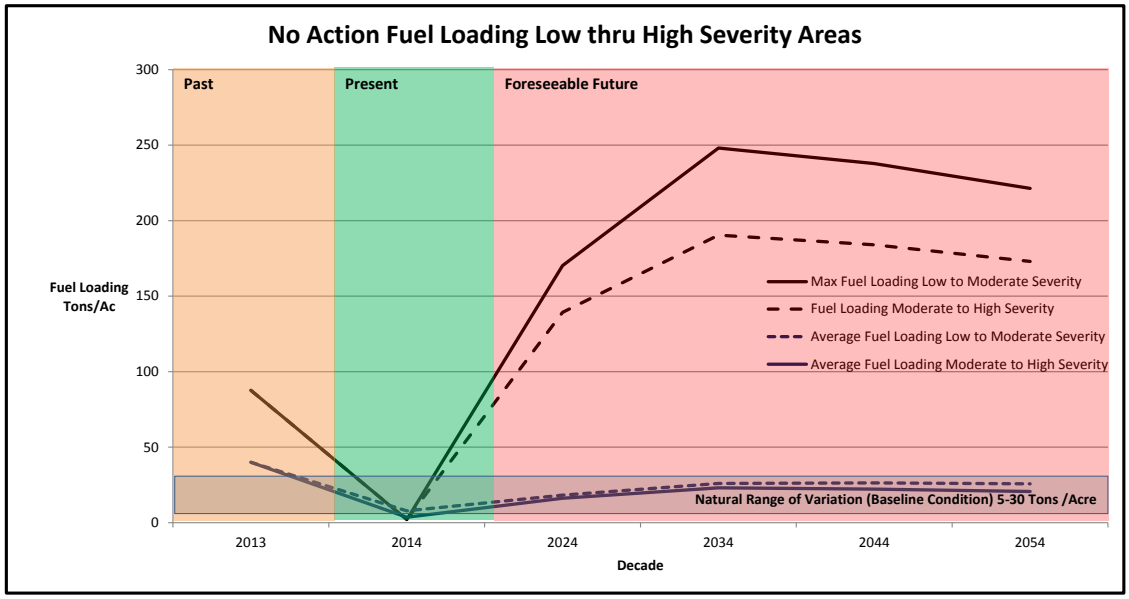


Figure 7. Potential Fuel Loading Comparison, Low through High Burn Severity Areas.

In the moderate and high severity fire killed areas – the fuel loading increases dramatically over time as a result of intact but dead tree crowns that will eventually fall in 5-15 years (Keyser and other 2008; McIver and Ottmar 2007). In the low and moderate severity areas, the surface fuel loading increases are a result of the post fire bug killed trees that will eventually die and add to the post fire residual surface fuels that were not consumed by the initial fire (Stephens and others 2012; Hoffman and others 2012).

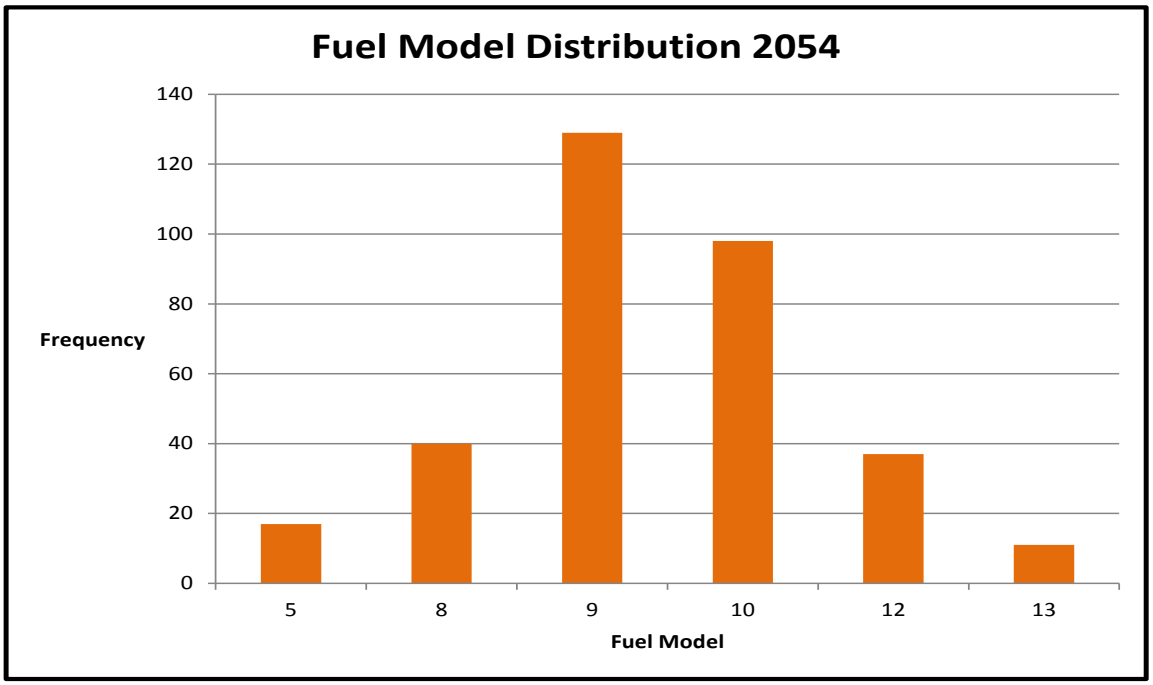


Figure 8. Fuel Model changes by 2054 as calculated in FVS modeling runs from collected plot data (represented by frequency) in 2014.

The increases in fuel loading is represented by fuel models moving from FM 2, 5 and 8 into FMs 9,10, 11, 12 and 13 (Figure 8). These latter fuel models represent the higher fuel loadings and timber with brush in the understory (FM10) and slash models (FM 11-13) from what was immediately post fire FM5 (brush). The areas where there is 100 percent mortality with tree crowns intact would eventually become surface fuel loading; bear clover and brush would also begin to take over the site until trees can reestablish naturally along areas of surviving seed trees. Heavy surface fuel loading from fallen snags with a large brush component is one of the factors that makes suppressing a wildfire difficult to control.

Fireline production is a measure of the ability for wildland fire to be controlled. The more fireline that can be produced in a short period of time the easier the fire is to control. Table 20 below shows how fireline production (fuel loading subindicator) drops and surface fuel loading increases.

Table 20. Handcrew (20 person) Fireline Construction Capability (NWCG 2004).

Fuel Model	Initial Attack Chains per hour#	Initial Attack Feet per hour	Sustained Attack Chains per hour	Sustained Attack Feet per hour
2	4	264	24	1584
5	0.7	46	6	396
8	2	132	7	462
9	2	132	28	1848
10-12	1	66	6	396
13	0.04	2.64	6	396

#1 chain = 66 feet.

Fireline construction capability rates go from 1,584 feet of fireline constructed per hour in a FM2 to less than 396 feet per hour in a FM 13 with brush a 76% reduction. The drop in firefighter fireline production rates (decreasing efficiency in controlling fire) places firefighters at risk and dramatically increases the residence time that allows a fire to burn hotter and increases spotting potential. Fire persistence (residence time) and resistance to control (low fireline production rates) are largely influenced by loading, size and decay state of large woody fuel (Petersen and others 2009, Brown and others 2003). During the initial and early extended attack of the Chips Fire on the Plumas National Forest in August of 2012 this was very apparent for the crews cutting fireline up out of the Feather River Canyon. “Line production rates were very low and overall firefighter risk due to hazard exposure was elevated working in the burned landscape fuelbed created by the Storrie Fire 12 yrs previous” (Adams, Wilson 2015).

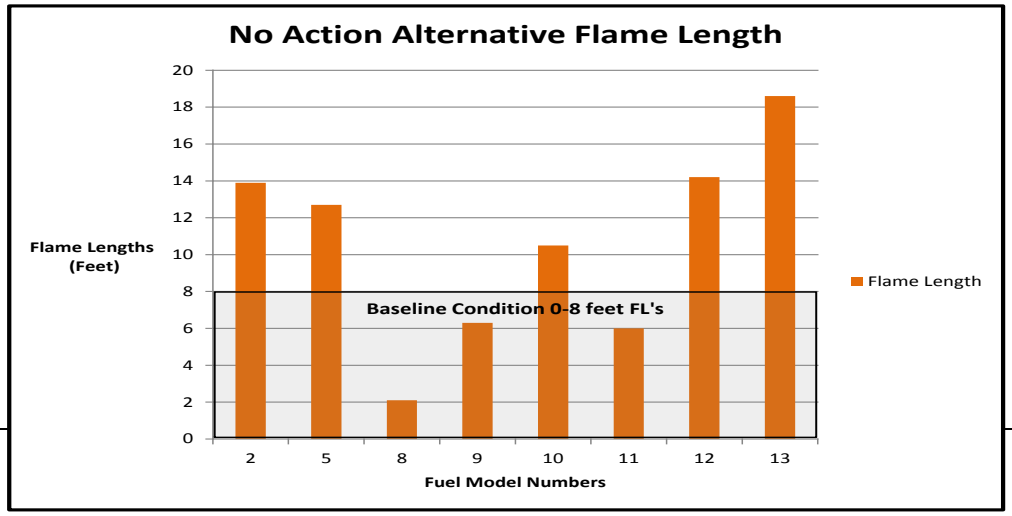
Invasive weed infestations’ such as medusa head would likely increase in size and scale and become a future fuel bed that increases fire potential. Small roadside burns in southeastern Los Angeles ponderosa pine woodlands often become dominated by medusa head and cheat grass. These communities often accumulate fuel contributing to repeated and increasingly larger fires (Christenson and others 1974). Invasion can initiate a cycle where a non-native grass colonizes an area and provides the fine fuel necessary for the initiation and propagation of fire. Fires then increase in frequency, area, and possibly severity. Following these grass-fueled fires, non-native grasses recover more rapidly than native species and cause a further increase in fire (D ‘Antonio and others 1992)

Figure 9. Hand fireline constructed during the initial days of the Chips Fire on the Plumas National Forest, August 2012. The snags were created from the Storrie Fire that burned 12 years earlier in August of 2000.

Indicator 2: Flame Length

After a wildfire, depending on fire severity and fuel consumption, there is usually an immediate, short-term decrease in abundance of coarse and fine woody fuel, potentially reducing subsequent fire intensity and severity in the short term. However, with time as snags fall, fuel loading may exceed pre-fire fuel loading and future potential fire intensity and severity increases, potentially well above the pre-fire potential (Johnson and others 2013, Keyser and other 2008). As stated above, heavy surface fuel loads generally contribute to longer flame lengths. The table below displays the flame lengths for the fuels models projected to occur over time.

Table 21. No Action Alternative Flame Length over all Burn Severity, representing the year 2054.



Van Wagtendonk and others (2012) found that in Yosemite National Park (YNP) when areas reburned, the portions of unchanged severity fire decreased in acres while the portion of high severity fire has increased. This evidence has fire managers concerned about the fire intensity of future fires that may reburn in the Project area and the effects on fire fighters' safety. They also found that as high severity burned areas such as the French Fire converted to bear clover and chaparral they were more than twice as likely to reburn at high severity and that reburn potential increased after nine years or longer from initial fire. Miller and Safford (2012) and Miller and others (2012c) found that the annual area of high severity fire increased in the period from 1984 to 2010 in yellow pine mixed conifer forests. This reburn potential and a nine year time frame was also noted by McIver and Ottmar (2007), and Donato and others (2009). This reburn would then coincide with the increases to surface fuel loading from snag fall. McIver and Ottmar (2007) found that other components of the fuel bed (live fuel such as grasses and brush) are a major influence in wildfire intensity about one decade after first fire. Due to the density of small trees and slash fuel from fire killed small trees, even a moderate wildfire will tend to be relatively severe.

This reburn potential has been observed for wildfires and during prescribed fire operations (Petersen and others 2009, and personal observations) where snags are a source of spot fires and heavy down woody debris is a magnet for spot fire increasing the resistance to control. Where high winds occur, the sustained burning of persistent fires can be fanned into fast moving, dangerous fires as in the Big Meadows fire of 2009 (YNP) and in the High Glade and Campbell fires of 2013 on the Mendocino and Lassen National Forests (personal conversation with Sierra fire crews 2013).

Ritchie and others (2013) state that "elevated surface fuels can contribute a significant risk to the succeeding stands (Agee and Skinner, 2005) and present a challenge and safety risk to fire crews and the subsequent burn of these areas". Petersen and others (2009) document the reburn potential of wildfires around the west from treated and untreated post-wildfire snags and fuel hazards, and found that emerging tree's crowns with a shrub layer also present a fire hazard as the low canopy base height of the emerging trees creates torching potential and increasing flame lengths over surface fires.

The location of the burned area within the San Joaquin River Canyon and the effects of the daily wind flow across the landscape have also been substantially altered by the loss of vegetation. Live vegetation such as trees and brush act as barriers to wind flow as it moves over the landscape. Sugihara and others (2008). The areas that have had all the vegetation burned away will now be exposed to much greater wind speeds at eye level until sufficient vegetation regrowth occurs to begin to reduce the winds at the surface. Figure 10 shows the Aspen Fire behavior on the landscape and the result.

Figure 10. BFAT team camera at Site 2 during the Aspen Fire and post fire.

Cumulative Effects

Cumulative effects for fire and fuels are defined by not only those reasonable foreseeable projects, but the fuel loading that develops from alternatives into the future. Specifically this analysis looks to 2054, for potential fuel loading, impacting flame length potential, within the Project area.

Alternative 1 would change the context of future fire flame length, intensity and fuel loading within the Project area by allowing snag fall across the area and vegetation growth over time. Surface fuel dynamics and potential future wildfire would be a function of pre- and post-fire live and dead biomass, litter fall (dead tree crowns), and tree fall (decay and time; as trees fall, decay and regrowth of vegetation change as time progresses). Because of these change dynamics and what is present on the post fire landscape, subsequent fire intensity would be specific to local conditions, spatially and temporally.

One project that affects fuel loading over time is the Mile High Roadside Hazard Timber Sale in the French Fire boundary. This project removes fire killed hazard trees along the major road (4S81) within the fire boundary. While this project does remove most of the large woody debris in that footprint, there are a percentage of large merchantable dead trees that would be left on the ground because of breakage during timber falling and logging operations.

This sale is providing a measure of safety for agency personnel and the public as they remove the tree related hazards created by the fire. Overall the Mile High Roadside Hazard Project provides little change in the amount of surface fuel loading that would increase over time in the Project area as the volume removed is small in proportions to the entire Project area. The Mile High Project does provide for a measure of immediate fire fighter and public safety within the Project area. Over the long term, the Mile High Project alone does little to provide for long term fire resilience, as the project's primary purpose was to alleviate immediate safety hazards and most of the immediate and short term fire resilience in the Project area is provided by the variations in the burn severity patterns of the wildfire.

Mechanical thinning and prescribed fire projects for a total of 11,403 acres occur in the vicinity or adjacent to this Project. Such treatments on Forest Service lands in the vicinity moves the forest toward desired conditions for forest resiliency and lowering fire intensity and severity over the district but none have influence within the Project area. The French Fire burned into the proposed West Chiquito Project that was in the planning stages for thinning and prescribed burning ecological restoration treatments. Approximately 1/3rd of the 20,000 acre

Project area burned. The future of the West Chiquito Project is currently uncertain due to the French Fire impacts and therefore predicting how this project would relate to cumulative effects is uncertain. If the West Chiquito Project were to move forward it would benefit the Project area since the surrounding area would have treatments to reduce fuel loading so there would be additional fire resilience in the surrounding area.

Indicator 1: Fuel Loading

The following summarization of risk and benefits are based on treatments that would not occur in the no action alternative.

1. Salvage Harvest Treatment, Road Hazard Removal, Defensible Fuels Profile Zone Areas, Reforestation activities;

a) *Risk:* Maximum Fuel loading in all size classes of fuels within Moderate to High and Low to Moderate severity will increase 508% and 686% over baseline conditions over a 50 year time span. Average fuel loading would remain with in baseline conditions but would be near the upper threshold of 30 tons/acre for over 30 years.
Woody shrubs would recolonize the site and grow up through all the down woody debris and create a dense fuel bed of both live and dead fuels. Fire suppression effectiveness becomes less and resistance to control increases.

Roads and DFPZ's would not be safe to utilize for fire control lines and would be difficult to hold during indirect fire suppression strategies. Aerial delivered fire retardant would be less effective.

The risk of injury from falling snags to firefighter, forest worker and recreating public would increase as these snags decay and fall over in time.

Fire effects from a future wildfire burning through these untreated fuels would be detrimental to ecosystem components such as water quality, soil and vegetation.

2. Invasive Weeds;

a) *Risk:* Fuel bed of flashy fine fuels that leads to increased fire occurrence and higher rates of spread.

Indicator 2: Flame length

1. Salvage Harvest Treatment, Road Hazard Removal, Defensible Fuels Profile Zone Areas, Reforestation activities;

a) *Risks*: Flame lengths would increase over the baseline condition of 0-8 feet in the following fuel models in year 2054.
FM 2 (Grass/Bear Clover) = flame length increases 75%

FM 5 (Medium size shrubs) = flame length increases 68%

FM 10 (Timber Litter) = flame length increases 25%

FM 12 (Medium Slash) = flame length increases 75%

FM 13 (Heavy Slash) = flame length increases 125%

Fuel Models 8, 9, and 11 remain below the threshold of 0-8 ft.

2. Invasive weeds;

a) *Risk:* Flashier fuels due to woody shrubs being converted to an annual grass fuel bed. Flame lengths in these areas would increase over the baseline condition but remain relatively uniform over time as these grasses do not grow very tall.
FM 2 (Grass) = flame length increases 75%

b) *Benefits:* Fires burning in grass type fuels while showing high flame lengths and fireline intensity would respond well to aerial delivered retardant which would assist with direct attack fire suppression strategies.

3.5.3.2. Alternative 2 – (Proposed Action)

Direct Effects

The biomass of snags (fire killed and secondary salvage) removed would have a substantial reduction on fuel loading and impact during a future wildfire (Brown and other 2003, Petersen and others 2009, Ritchie and others 2013). Fuel loading decreases in the treated areas to optimal levels of 5 to 20 tons per acre (Brown and others 2003) which influences decreased fire intensity and flame lengths.

Current and future invasive weeds would be managed with the use of herbicides with the goal of total eradication to prevent spread throughout the Project area.

Indicator 1: Fuel Loading

Post-fire salvage logging combined with pile and burn surface fuel treatments can greatly reduce the loading of fuels and subsequent fire behavior (Johnson and others 2013). Post-fire logging can substantially reduce future surface woody fuel levels in forests regenerating following wildfires (Peterson and others 2014). While some thinning treatment operations such as conventional harvesting may increase surface fuel loading (McIver and Ottmar 2007) immediately post-harvest, Johnson et al (2013) found that the use of whole tree harvesting and yarding minimized on site surface fuel accumulation. Tree removal followed by mechanical piling and pile burning considerably reduces fuel loading.

Proposed activity slash disposal would reduce fuel loading and continuity within the salvage harvest treatment units and along roads. Merchantable fire killed trees would be removed during salvage harvest. The Forest LRMP as amended by the 2004 Framework Record of Decision objective is to reduce both natural and activity-based fuels hazards through methods such as prescribed burning, mechanical or manual manipulation of forest vegetation and debris, removal of forest vegetation and debris, or combinations of these methods (SNLRMP 2004)

As part of the Project design, post-harvest assessment of activity slash would determine the appropriate treatment for slash disposal for reforestation activities. This assessment would determine the fuel hazard and fire risk based on aspect, slope, surface fuel loading, access and location of salvage unit. Activity created slash less than 10 tons per acre would be considered for lopping and scattering. Lopping and scattering activity fuels would not change the fuel load following salvage harvest, but would reduce the vertical and horizontal continuity of the fuel bed. Slash concentration greater than 10 tons per acre would be considered for mechanical piling and burning, or jackpot broadcast burning to reduce fuel loading for reforestation and to increase suppression success. These slash disposal treatments would reduce fire hazard by decreasing fire behavior characteristics (rate of spread, intensity, severity, crowning, spotting distance, fire duration and resistance-to-control). The reduction in flame length and fire intensity would result in reduced risk and increased safety to fire fighters. This action would result in greater flexibility in fire suppression tactics and enhance the probability of success.

Areas planned for conifer reforestation following site preparation and in the DFPZ locations that are treated with herbicides would see a fuel model change through a large portion of these areas from woody shrubs such as bear clover and manzanita to a more annual grass type fuel bed. Past herbicide treatments have not totally removed all shrubs out of the sprayed areas due to the applicators missing areas as they work through the units. (B. Stalter 2015) While both types of fuels are modeled as a Fuel Model 2 in this report and exhibit greater flame lengths and fireline intensity over the baseline conditions, the grasses would be an easier fuelbed for

suppression forces to construct fireline in versus bear clover and aerial delivered fire water/retardant would be more effective in these lighter fuels.

The heavy fuel loading along the Southern California Edison transmission line right of way would be removed and cleaned up to protect the infrastructure. It would also keep fuel loads low in this zone to help limit any future fire spread.

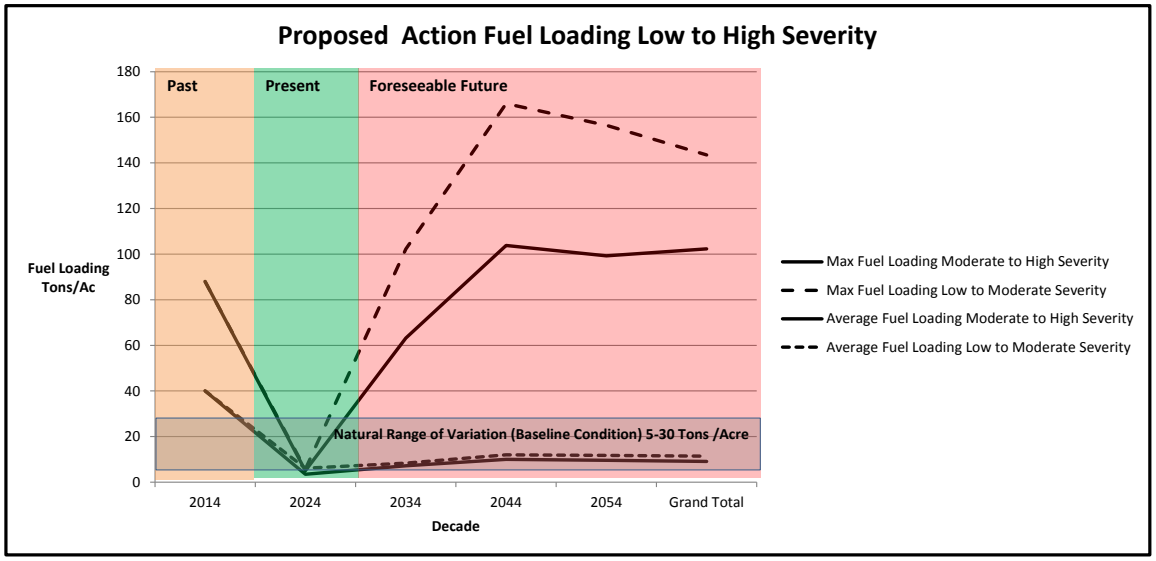


Figure 11. Proposed Action Potential Fuel Loading Comparison in the Low thru High Burn Severity Areas.

In the figures 12 and 13 below the surface fuel loading across the average and maximum is substantially reduced as a direct effect of the proposed action for a period of 50 years as well as reducing the overall surface fuel loading over time. A comparison between the No Action alternative and the proposed action over all the treatments for the maximum and average fuel loadings, high and moderate severity areas would reduce fuel loading by an average of 36% - 45% over a 50 year time frame. In maximum and average fuel loadings within low to moderate severity areas fuels are reduced by an average of approximately 47-48%. The difference in fuel loading between the moderate/high and the low to moderate is dependent on the amount and extent of time that the post fire insect induced mortality occurs within the fire area. The maximum fuel loading levels would be the same as in the no action alternative with these following tables (figure 13 and 14) representing areas where no treatment has occurred or where treatments have occurred and pockets of snags were left for wildlife habitat and have fallen to the ground. These areas would be scattered throughout the Project area and would likely be left for CWD needs. The average fuel loading would represent the conditions post treatment in the proposed action areas.

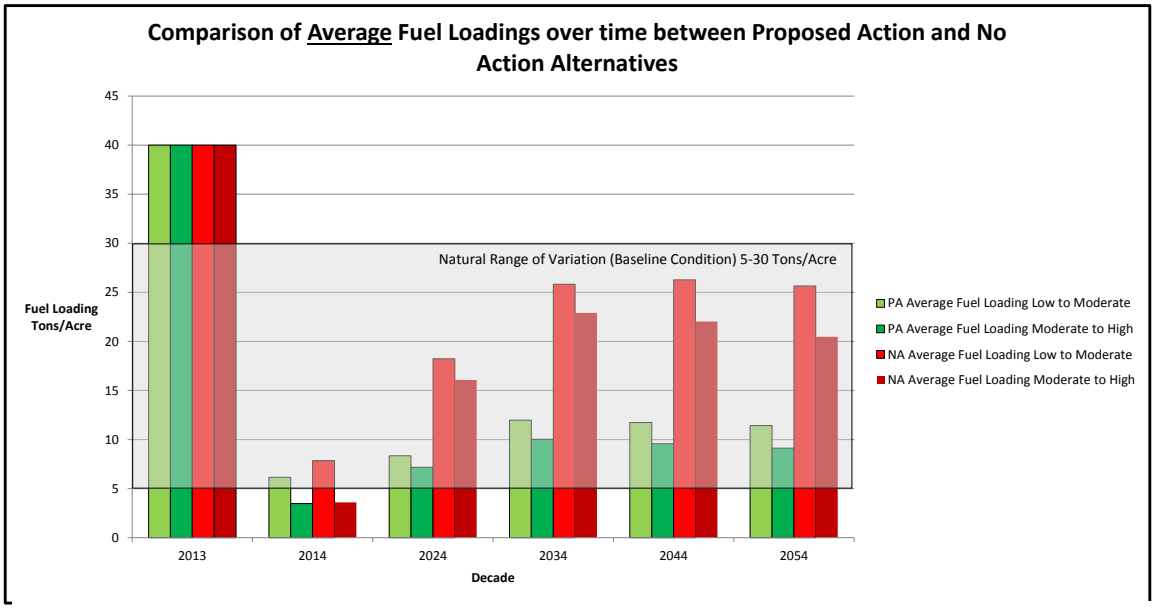


Figure 12. . Comparison of Fuel Loadings over time between Proposed Action and No Action Alternatives.

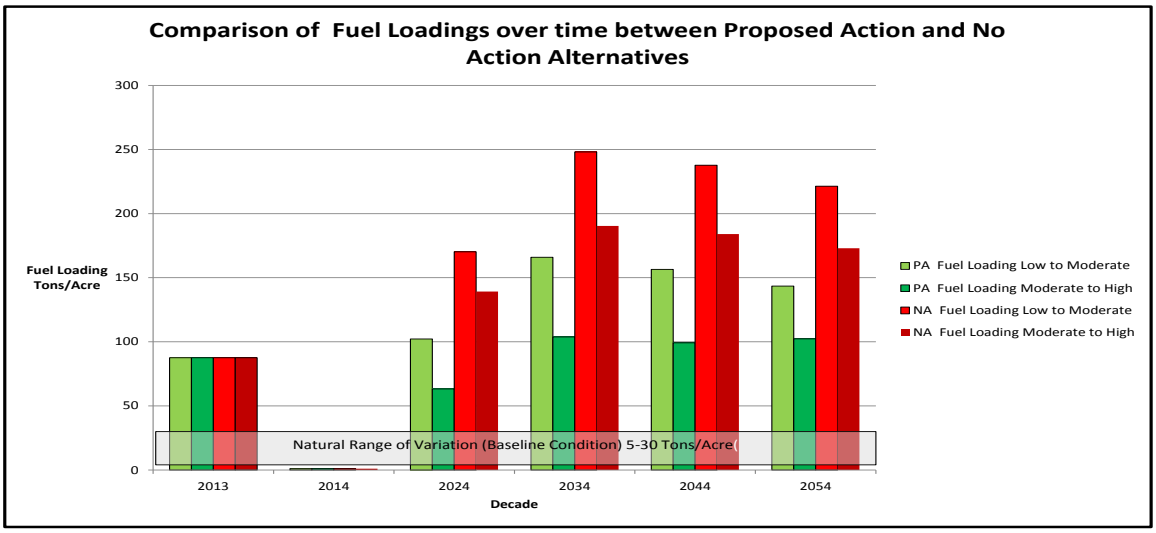


Figure 13. Comparison of Max Fuel Loading between the Proposed Action and No Action Alternatives.

Forest plot data used for research showed that stands of timber with 100% mortality, with crowns intact have an average of 480 trees per acre at about 10 inches in dbh. The crown fuel loading from these trees (to a 6 inch diameter) is about 243 pounds per tree; with approximately 480 trees per acre, the residual fuel loading adds about 48 tons per acre (Harrell 1978) in these types of stands. Under Alternative 2, salvage harvest and residual slash treatments would remove this fuel, reducing the fuel hazard to within an optimal range as given by Brown and others (2003), Peterson and Others (2009) and Safford (2013). This same level of tree crown fuel loading can be expected from the post-fire bug induced mortality (B. Stalter, personal observations).

Indirect Effects

Indicator 2: Flame Lengths

The indirect effect of removing snags and post-harvest slash treatments is the reduced fire intensity in the treated stands where fuel loading in the larger size classes will remain low. Post-fire logging produced a transient pulse of elevated surface woody fuel loadings followed by a much longer period of reduced surface woody fuel loadings, relative to burned stands that were not logged (Peterson and others 2015). While this would in the short term increase fuel flammability due to the increase in lighter fuels the long term benefit is an overall reduction in fuel loading that would be available to burn in a future wildfire. The figure below displays the potential flame lengths for predicted fuel models that would occur within the treatment areas.

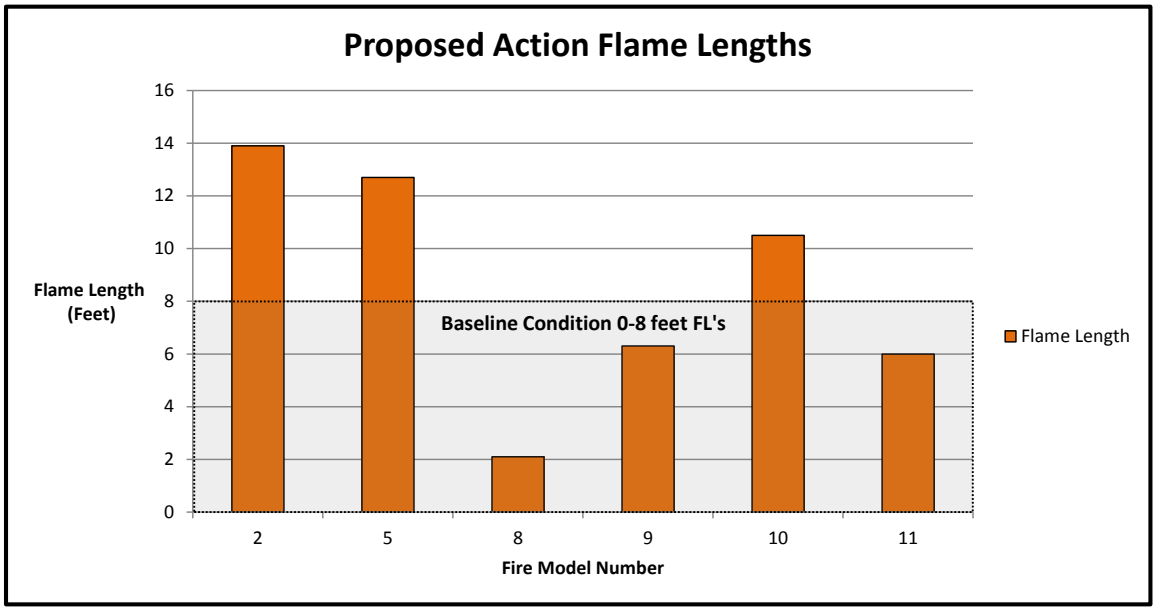


Figure 14. Proposed Action Flame Length for projected Fuel Models within treatment areas in year 2054.

High severity fire is a key component in structural heterogeneity and biodiversity. Untreated areas of the French Fire area would provide for habitat needs and still present conditions that are at risk of high intensity fire due to the natural fuel loading that will continue through time.

There are mixed and contrarian views regarding the removal of dead trees and the decreased intensity of future fires (Beschta and others, 1995). Recent research by van Wagtendonk and others (2012) as well as fire information from 2013/2014 wildfires (personal conversation) has found that post wildfire fuel loading does indeed influence fire intensity and resistance to control and places fire fighter safety at risk. The 2009 Big Meadows fire escaped control lines as the fire spotted into natural regeneration and heavy fuels from the 1990 Arch Rock Fire. Spotting well ahead of the main fire also occurred from snag to snag to spread fire outside of control lines and eventually lead to spotting well outside the ability of firefighters to control (personal experience 2014). Heavy fuel loading and snags were identified in the fire review as a main contributor to fire intensity and spread.

Safford and others (2012) found that fire intensity and tree mortality are generally much lower in fuel treatments. This has implications for the low and very low severity areas where the fire did not remove the previously existing fuel load and any fire induced mortality or post-fire bug mortality could dramatically affect the intensity of future fires in these stands. Safford and others (2009) found from the data that in the Angora fire, fuel loading was generally more important than topography in driving fire severity. Rhodes and Baker

found in 2008 that fuels treatments are rarely encountered by wildfire and that they are unlikely to reduce the effects of high severity fire. Since 2008, multiple studies have been conducted regarding fuel treatment effectiveness when encountered by high intensity wildfires and the claims made in earlier studies are no longer valid (Stevens-Rumann and others 2013, Safford and others 2012, McIver and Ottmar 2007).

While Bond and others (2009) stated she found no compelling evidence that pre-fire tree mortality due to insects and drought had any effect on fire severity in her studies on the San Bernardino NF, she also stated that she did not consider the influence small trees have in fire severity because of lack of small tree size classes in her study. This is a different scenario within the Project as there are large stands of dead small trees that will eventually fall, increase fuel loading and become a primary driver of high intensity fire.

Stevens-Rumann and others (2013) also found, like many other studies in the west, that fuels treatments can result in reduced fire severity and in long term difference in stand recovery. Where high severity fire has removed the canopy or opened the canopy, the rapid release of growing space (shrub and herbaceous regeneration), an increase in surface wind speed and the potential for reduced dead fuel moistures will have an increase in surface fire intensity (Johnson and Others, 2011). Rhodes and Baker (2008) do acknowledge that current findings suggest treatment effects on fire severity are mostly confined to treated areas, and that theory suggests a dense network of treatments might slow fire spread and reduce intensity, yielding a landscape effect on fire (Ritchie and others 2013, Stephens and others 2012). Omi and Martinsen (2003) found from the Angora fire data that fuels treatments can facilitate suppression efforts by providing safe access and egress for firefighters. The effect of reducing fuels in the Project is a reduced number of suppression resources needed for fire suppression. Smaller fires require fewer firefighters, which in turn reduces the number of firefighters exposed to hazards. In addition, smaller fires expose fewer numbers of the public to the hazards of wildfires not only in the general forest but also in degraded air quality influenced by high intensity wildfire emissions.

The DFPZ's concept for this Project was taken from the historical pre-attack maps and process that was initially developed in the late 1960's and early 70's. Also utilized for a design and planning strategy for these features were the eight elements of an alternative approach to fuel breaks by (Ingalsbee 2005). The key element focusing on using these areas for future landscape scale fire management. The topographic features that have been chosen for these treatments are the "strong ridges" that firefighters normally utilize when building the containment box for a wildfire. These ridges were initially utilized and prepped during the Aspen Fire in 2013 as contingency lines if the fire spotted across the San Joaquin River. The original pre-attack maps were utilized during this operation. During the French Fire in 2014 these same contingency lines were utilized for the indirect suppression strategy that resulted from the large fire runs that burned out of the Rock Creek drainage after initial attack became unsuccessful. These pretreated areas served as safe ingress and egress areas for equipment and crews and saved many days' worth of very difficult fireline construction down into one of the roughest sections of the San Joaquin River Canyon. Reduced exposure time for the crews and equipment was a strong benefit from having these areas already cleared of heavy fuels and brush making the subsequent backfiring operation very successful and completed in a very short time. These treated areas would also be beneficial for future prescribed burning and managed wildfire for managing fuel loads in the project area including the reforested areas when they reach a large enough size to survive low intensity type burns which research shows to be at 20-25 years in age McGinnis 2010).

Figure 15. Historical vegetation conditions on the Bass Lake Rd circa early 1900's. Notice the open nature of timber stands and bear clover mixed with patches of grasses and low chapparral cover. Fire return interval was 7-10 years. (SNF Historical Photo Collection)

Treatment areas that are planned for reforestation with conifers and areas of invasive weed eradication where herbicides are used as the vegetation management tool would alter the existing native vegetation fuel bed that would recolonize the site. This change in fuelbed from a mainly bear clover dominated cover would be temporarily moved to a grass type fuelbed. Both of these fuel beds are modeled by Fuel Model 2. The effect this change would have on flame lengths is that the grass fuelbed would be easier to construct fireline in and aerial delivered water/retardant would be more effective at keeping the fire intensity down to safe levels for fire personnel and equipment. Constructing fireline in bear clover is a very difficult and labor intensive (B. Stalter, 2014, personal observation).

Whereas shrubs can produce higher flame lengths than other surface fuels, they do not readily ignite until late in the fire season, when fuel moisture is low, especially if they have a high proportion of live braches. In contrast, litter and grass fuels produce lower flame lengths, but dry earlier in the year and ignite easily (Agee et al., 2002) While the above reference is accurate for shrubs such as young aged stands of manzanita and ceanothus chaparral being a potential heat sink during young ages the project area that reforestation is planned for was composed of 90-98% bear clover shrubs prior to the fire so this is going to be the initial recolonizing shrub to take over the site first.

The areas affected by invasive weeds currently is small in size relative to the Project area but after herbicide applications these patches would be similar to the reforestation areas and would take 5-10 years for shrubs to begin to reoccupy the site similar and similar fire behavior is modeled to occur.

Flame lengths would meet the baseline conditions in 3 of the 6 fuel models that would be representative of the post treatment fuel beds. These are in fuel models 8, 9, and 11. The remaining 3 fuel models (2, 5 & 10) illustrate flame lengths ranging from 31% to 78% above the base line condition. These 3 fuel models would be the reforested areas, invasive weed sprayed areas and the untreated areas of low to moderate severity that would have a heavier fuel loading due to the limited amount of treatments planned across these areas.

Cumulative Effects

Appendix F displays the past, present, and reasonably foreseeable projects on the BLRD. The alternative 2 treatments benefit the resiliency of timber stands in terms of fire behavior intensity and severity in the Project area.

Unless Appendix F projects are directly adjacent to Project they will have little to no effect on the Project area but many will have an overall effect of improving the resiliency of the forest to the effects of severe wildfire, primarily those projects in pine or mixed conifer forest types. Those projects that have prescribed fire underburns' as a fuels treatment provide ecological benefits to the forest as a whole by creating and increasing the heterogeneity of the forest and restoring some of the ecological processes that fire on the landscape provides. Forest restoration treatments and prescribed burns have the most direct and indirect effects of fire behavior and forest resilience by reducing flame lengths and removing surface and ladder fuels that promote high intensity fire. The cumulative effects of the timber thinning and burns (SCE and USFS) are reduced fire intensity, and reduced amounts of high severity fire (Stevens-Rumann and others 2013, Ritchie and others 2013 and Stephens and others 2012).

The use of herbicides as a vegetation desiccant for reforestation and DFPZ and invasive weed eradication activities would alter and reduce the live woody component out of the fuels profile over time. This fuel change would move the existing condition from a shrub type fuel to a more annual grass and forbs type fuel and would cause an increase in flame length and fireline intensity but aerial water/retardant would be more effective at moderating fire behavior in these lighter fuels for ground fire suppression resources. There is some risk of increasing the fire return interval in areas that were originally shrub dominated historically but the areas that this could happen are limited in scale in relation to the overall Project size. This is mainly in the chaparral dominated areas outside of the conifer belt and is in the southern portion of the Project area in the DFPZ treatment that extends down into the San Joaquin River Canyon. The areas that would remain unsprayed would show the same direct and indirect effects for fire and fuels as the no action alternative.

Cattle grazing in the Haskell and Chiquito allotments may benefit from the flush of new growth of herbaceous species, but the number of cow/calf pairs in each allotment may remain too small to reduce the potential fire intensity that the flush of vegetation presents in the rapid regrowth of understory vegetation.

Indicator 1: Fuel Loading

The following summarization of risk and benefits are based on treatments that would occur in alternative 2 (proposed).

1. Salvage Harvest Treatment, Road Hazard Removal, Defensible Fuels Profile Zone Areas and Reforestation activities;
   a) *Risk:* Maximum Fuel loading in all size classes of fuels within Moderate to High and Low to Moderate severity will increase 508% and 686% over baseline conditions over a 50 year time span. Average fuel loading would remain with in baseline conditions and would be near the lower threshold of 10 tons/acre for over 30 years.
   As noted in the fuel model charts the proposed action would distribute fuels in the models that are lighter in loading than the no action alternative which showed loading in fuel models 12 and 13 the heaviest loaded models of 13 fuel models in year 2054. The proposed action treatments are directly responsible for this redistribution by removing the largest woody component out of the fuel bed and cleaning up the residual slash and sub merchantable snags during reforestation site preparation activities.

   Woody shrubs would be reduced in the short term in reforested areas with herbicide treatment. Bear clover and shrubs converted to annual grasses mixed with planted conifers. Woody fuel loading in these areas would be the lowest because of site preparation slash reduction treatments. Fires burning in these grass type fuels while showing high flame lengths and fireline intensity over the baseline conditions

would respond well to aerial delivered water/retardant which would assist with direct attack fire suppression strategies by suppression forces.

Fire suppression effectiveness increases in treated areas and resistance to control lowers.

Roads and DFPZ's would provide for safe ingress and egress for fire resources and to utilize for fire control lines. They would be easier for holding operations with future fuels management prescribed burning, managed wildfires' and indirect fire suppression strategies. Aerial delivered water/fire retardant would be more effective.

The risk of injury from falling snags to firefighter, forest worker and recreating public would decrease as these snags are removed or felled under the proposed action treatments

b) *Benefits*- Fire effects from a future wildfire burning through these treated fuels would be at a severity level beneficial to ecosystem components such as water quality, soil and vegetation. These treatments would help provide a solid anchor point in which future fires could be managed for resource benefits.

2. Invasive Weeds- Non-native annual grasses and forbs;
   a) *Risk:* Fuel bed of flashy fine fuels that leads to increased fire occurrence and higher rates of spread.
   b) *Benefits:* There would be no benefits in fuel loading from invasive weed establishment

Indicator 2: Flame length

1. Salvage Harvest Treatment, Road Hazard Removal, Defensible Fuels Profile Zone Areas, Reforestation activities;
   a) *Risks*: Flame lengths would be over 8 feet in the following fuel models.
   FM 2 (Herbicide Sprayed, Conifer Reforested Areas, grass dominated) = Increase in flame lengths 78%

   FM 5 (Medium size shrubs) = Increase in flame lengths 68%

   FM 10(Timber Litter snag patches) = Increase in flame lengths 31%

   Fuel models 8, 9 and 11 remain below the baseline conditions of 0-8 ft.

2. Invasive weeds;
   a) *Risk:* As invasive weeds are sprayed and controlled with a non-selective herbicide such as Glyphosate the short term would see these areas recolonized with annual grasses and forbs. Native woody shrubs would be delayed being able to reestablish back into these sites. The effects of flashy fuels would be the same as in the reforested areas.
   b) *Benefits*: Fires burning in grass type fuels while showing high flame lengths and fireline intensity would respond well to aerial delivered retardant which would assist with direct attack fire suppression strategies.

3.5.3.3. Alternative 3 – (No Herbicide)

Direct Effects

The difference in effects between Alternative 2 and 3 result from the use of hand work to address site preparation and noxious weeds. The effects of removing snag and other trees is the same as in Alternative 2; therefore this effects analysis focuses on the changes related to shrubs and weeds under Alternative 3.

As described in Section 2, under this alternative reforestation strategies would occur as described in alternative 2; however no herbicides would be used to control bear clover, and competing brush that sprouts from roots or stump collar, including deer brush, whitethorn, and green leaf manzanita, during reforestation efforts. Live woody fuels (shrubs) dominate the overall surface fuel complex for a short time after stand-replacing fire and

are not substantially different between logged and untreated stands. Furthermore, because logging fire-killed trees does not greatly impact shrub cover, it does not majorly impact grass and forb fuels. Grasses and forbs are suppressed by dense shrub fields (McGinnis 2010). The dominant shrub that will reoccupy most of the proposed treatment sites will be bear clover as this was the dominant shrub prior to the fire. When fire or other disturbance occurs at regular intervals, bear clover attains sub canopy dominance within 3 to 4 years and remains dominant until the next disturbance. (Burcham 1957). Other dominant species that will reestablish in areas not occupied by bear clover are manzanita, ceanothus and young hardwoods.

The biomass of woody shrubs as they reoccupy the site in the reforested areas, DFPZ's and invasive weed areas would increase the fuel loading of above live fuels and depending on the timing of the future fire could have positive or negative impact. Results from the Mountain Fire Fuel Treatment Effectiveness Summary concluded the following in regards to shrub cover: The severity field data showed that, in areas with taller pre-fire shrub cover, effects on substrate and vegetation tended to be more severe during the Mountain fire. In support of this conclusion, substrate and vegetation severity was lower where shrub heights were less than about 6 feet. Lower severity effects can be expected in treatments up to about 7 years–since-treatment. (Reiner 2014). This illustrates that the young aged shrubs because they are composed of more younger wood and less dead wood would act as a heat sink and absorb energy from the flaming front of a wildfire and unless extreme winds or if very low live fuel moisture conditions occur fire spread may be reduced in these areas. Typically live fuel moistures of over 100% begin to limit fire spread in standing shrubs in the project area unless driven by strong winds and steep terrain. This condition would be limited in the project area would only in occur in the taller shrub fields of chaparral and not in the bear clover shrubs which are one of the most flammable live shrubs throughout the year as experience from numerous prescribed burning operations (B Stalter 2015).

Current and future invasive weeds would not be eradicated with the use of herbicides and the goal of total eradication to prevent spread throughout the project area would be more difficult to achieve due to more labor intensive hand pulling methods. The reestablishment of native vegetation shrub cover would help limit any future invasive weed invasion after the initial population is removed. The dense growing nature of woody shrub establishment after disturbance fully utilizes most of the site resources mainly water and this competition does not allow annual grasses and forbs to grow into these areas.

Indicator1: Fuel Loading

Fuel loading in live biomass shrubs that will reoccupy the site would be greater than alternative 2 and is represented by fuel models 2 (Bear Clover) and 5 (young aged chaparral mixed with plantation conifers). Fuel loading in these younger aged shrubs would be light from 0.5 to less than 5 tons per acre.

Fuel loading would remain within the baseline conditions of 5-30 tons acre and would be closer to the bottom end of the fuel loading range for the first 20 years. If not managed loadings would be above the baseline conditions within 40 years when fuel loads of shrubs mixed with litter fall from plantation trees and snag fall are likely to be above 30 tons per acre. Fire could not be used as a fuel management tool in the reforested areas until the planted trees reached diameters of 5-6" inches dbh or greater. Due to the poor survival and growth rates in bear clover shrubs this could be upwards of 70 years (Smith 2015, Silviculture Report).

Indirect Effects

The fire effects of a fire burning in these stands with a bear clover as the dominant shrub would burn very intensely for this given fuel bed. Shrub fuels vary substantially in heat content. Waxy or oily shrubs such as bear clover burn quite hot compared to other shrubs that burn at lower heart values. (Agee 1996). Flammability in the bear clover shrub fuels allow it to burn throughout all 12 months' of the year compared to grass type fuels which are the most flammable for only 6-7 months out the year. The shrubs represented by fuel model 5 would be flammable for the hottest driest part of the summer months when live fuel moistures are at their lowest values but would lower in flammability as the live fuel moistures recovered to greater than 100%. As these shrubs age and composition of more dead wood increases the flammability while still providing reduced

flammability benefits begins to increase due to more woody material that is not influenced by the live fuel moisture component.

Indicator 2: Flame Lengths

The indirect effect of flame lengths with this alternative is an overall increase over the baseline values of 0-8 ft. for fire suppression ability. Flame lengths shown in this alternative for fuel models 2 and 5 represent similar flame lengths as the proposed action by 2054.

Cumulative Effects

The non-use of herbicides as a vegetation desiccant for reforestation, DFPZ establishment and invasive weed eradication activities would not alter or reduce the live woody component out of the fuels profile over time. The fuel change would remain stable in the bear clover dominated fuels (FM 2) and would increase in the chaparral established areas. Both of these fuel beds would cause an increase in flame length and fireline intensity with the FM 5 having the lowest flammability throughout the year due to live fuel moistures Use of fire and a future fuels treatment tool would be severely constrained due to the increased shrub coverage and size as well as more intense burning conditions in the bear clover fuels. The past, present and future project impacts would be similar to the proposed action.

Indicator 1: Fuel Loading

The following summarization of risk and benefits are based on treatments that would occur in the no herbicide alternative.

1. Salvage Harvest Treatment, Road Hazard Removal, Defensible Fuels Profile Zone Areas and Reforestation activities;
   a) *Risk:* Maximum Fuel loading in all size classes of fuels within Moderate to High and Low to Moderate severity will remain relatively stable and under baseline conditions for 35-40 year time span. Fuel loads past this time would begin to move above the baseline condition due to falling snags and woody accumulations' from tree growth.
   Woody shrubs would be established throughout the reforested areas and DFPZ's. Bear clover and shrubs would be mixed with planted conifers. Initial woody fuel loading in these areas would still be the lowest starting out because of site preparation slash reduction treatments. Fires burning in these shrub type fuels would over the baseline conditions and would initially respond well to aerial delivered water/retardant but this would lower over time as the FM 5 shrubs become established and grow larger in size. The Fuel model 2 bear clover would respond to aerial water/retardant but this would be offset by the very low fireline production rates for the ground crews who would be constructing line.

   Fire suppression effectiveness is limited in treated areas and resistance to control increases.

   Roads and DFPZ's would become less effective for safe ingress and egress for fire resources and to utilize for fire control lines. They would be more difficult for holding operations with future fuels management prescribed burning, managed wildfires' and indirect fire suppression strategies. Aerial delivered water/fire retardant would be the same as above.

   Use of fire as the fuels management tool would be very constrained in reforested areas due to fuel loading in bear clover and shrubs that would lead to increased fire behavior that young conifer trees would not survive through.

   b.) *Benefits*- Fire effects from a future wildfire burning through these areas would be a mix of benefits and detriments to ecosystem components such as water quality, soil and vegetation while all the former would likely benefit, the ability of tree cover to reestablish over the high severity areas would be likely be very

compromised by a future fire. These treatments would be of limited use in helping provide solid anchor points in future fires used for resource benefits outside of the reforested areas.

Indicator 2: Flame length

1. Salvage Harvest Treatment, Road Hazard Removal, Defensible Fuels Profile Zone Areas, Reforestation activities;
   a) *Risks*: Flame lengths would remain similar to alternative 2 in the baseline condition of 0-8 feet in the following fuel models;
   FM 2 (Conifer Reforested Areas that are Bear clover dominated) = same as alternative 2.

   FM 5 (Medium size shrubs) = same as alternative 2.

   b) Flame lengths would increase over the baseline condition of 0-8 feet in the following fuel model;

   FM 10(Timber Litter snag patches) = Increase in flame lengths 31%

   Fuel models 8, 9 and 11 remain below the baseline conditions of 0-8 ft.

   The DFPZ treatment areas would be less effective at providing a anchor point for fire management in the long term. The conifer reforested areas would remain vulnerable to high tree mortality from fires(wildfire) until they reach ages greater than 20 years (McGinnis 2010). But due to the increased competition that would reduce growth of these trees from the FM 2 bear clover the time to reach a safe size for fire survival would increase to 70 yrs. The fuel bed in these areas would not support fire suppression effectiveness due to the very slow fireline production rates and high fireline intensity that bear clover produces when it burns. Aerial delivered retardant/water supporting ground forces is effective at slowing fires in these fuels but this advantage is lost if crews cannot construct line fast enough.

   c) *Benefits*- Fires burning in the FM 5 fuels while showing high flame lengths and fireline intensity will because of low live to dead wood fuel composition and live fuel moistures have a low flammability for all but the hottest driest part of fire season which would assist with direct attack fire suppression strategies.

3.5.3.4. Alternative 4 – (Hazard Tree and Plantation Salvage Only)

Direct Effects

Fuels loading under this alternative within the treated areas are similar to the proposed action and the areas that would not be treated would be similar to the no action alternative.

Indirect Effects

Flame lengths under this alternative within the treated areas are similar to the proposed action and the areas that would not be treated would be similar to the no action alternative.

Cumulative Effects

Cumulative effects under this alternative within the treated areas are similar to the proposed action and the areas that would not be treated would be similar to the no action alternative.

3.5.3.5. Alternative 5 – (No Secondary Entry)

Direct Effects

Fuels loading under this alternative within the treated areas are similar to the proposed action and the areas that would not be treated would be similar to the no action alternative.

Indirect Effects

Flame lengths under this alternative within the treated areas are similar to the proposed action and the areas that would not be treated would be similar to the no action alternative.

Cumulative Effects

Cumulative effects under this alternative within the treated areas are similar to the proposed action and the areas that would not be treated would be similar to the no action alternative.

3.6. Forest Health (Vegetation)

3.6.1. Background and Affected Environment

The focus of vegetation and silviculture analysis is to address the effectiveness of each alternative in meeting the purpose and need for the Project related to reforestation and establishment of conifers, retention of snags, and harvest of fire affected trees, while also taking into the consideration of current weather and forest health conditions. Drought conditions combined with high insect activity and fire injured trees directly relate to harvest of fire affected trees as well as flushing.

Conifer Reestablishment and Growth

Areas disturbed by fire create canopy openings and conditions suitable for secondary succession. Secondary succession is a process of reinvasion by plant species following disturbance (Barbour et al. 1980). The response to disturbance is determined by the availability of seed and the competitive advantage of the first species to arrive following that disturbance. While conifer, oaks and brush can survive or establish after disturbances such as fire or harvest, the pattern of response is often dictated by the available seed, high severity patch size, and conditions suitable for tree growth (soil moisture and bare soil) and treatments (McDonald and Fiddler 1995, Bonnet et al. 2005). While disturbance can change the proportion of species succession, succession will result in predictable combinations of species that form vegetative communities; this tendency for vegetation to form communities is often referred to as potential natural community or potential natural vegetation (Potter 1994). Action alternatives change secondary succession to increase the pace and scale of conifer regeneration. The faster trees grow the more quickly they will provide structures for ‘old forest” dependent species.

The French Fire killed most small conifer trees (less than 10 inches dbh). Surviving trees in the less than 10 inch dbh size class tend to be found in clumps. Most surviving young conifers are found in very low fire severity areas.

Seed dispersal affects the rate at which conifers reoccupy fire created openings. Conifer seed is primarily dispersed by wind and secondarily dispersed by animals (Fowells and Shubert 1956, Vander Wall 1992). Seed dispersal occurs within 150 to 300 feet of surviving conifers (Fowells and Shubert 1956, Bonnet et al. 2005, Caprio et al. 2006). The French Fire created large patches of high and moderate to high severity some up to 2 miles long by ½ mile wide. These large openings are beyond the reach of most pine seed dispersed by wind or animals.

The periodicity of cone crops also affects the rate of conifer secondary succession. Pine species experience heavy seed crops every two to eight years, while white fir experiences heavy seed crops every two to 12 years

(Fowells and Shubert 1956). White fir and incense cedar can produce two to three times more seed in heavy seed years than pine species. White fir and incense cedar can grow in shade; while pine species require open sunny conditions. Delays in pine regeneration and the amount of fir/incense cedar seed produced, periodicity of seed, and ability to grow in shade favor the dispersal and survival of white fir and incense cedar. Franklin and Bergman (2011) in their study of regeneration following the Cedar fire in southern California noted that Jeffrey pine appeared to be at a distinct disadvantage for natural regeneration following a large, severe, stand replacing fire due to the limited time period every few years for seed dispersal. As bear clover brush and grasses reoccupy the site, open ground conducive for successful pine regeneration will become less available. In addition, to successfully germinate and survive, seed successfully falling onto a suitable growing site must have enough moisture and proper weather conditions to survive and grow.

Post fire studies indicate a variable conifer regeneration response dependent on secondary succession. Shatford et al. found abundant conifer regeneration following fires in Oregon and California (2007). In another study, Donato et al. found that following severe fire in Northern California, Douglas-fir seed (with its relatively lighter seed) was found throughout high severity patches to a distance of 1200 feet (2009). In contrast, the Sierra Nevada pine species and white fir that have a maximum dispersal distance of approximately 300 feet (Fowells and Shubert 1956).

Studies within the Sierra Nevada forests have found conifer regeneration lacking or dominated by species out of character with the pre-fire forest or restoration/recovery objectives. Collins and Roller (2013) found that within sampled fire areas the percentage of high and moderate severity patches and, to a greater extent, plots without pine regeneration was 72 percent (patches) and 87 percent (plots). Shrub cover was generally high, with approximately 60 percent of both patches and individual plots exceeding 60 percent cover. Collins and Roller (2013) found conifer regeneration was higher in areas with post-fire management activities (e.g. salvage harvesting, planting).

Crotteau et al. (2013) found that seedling regeneration in two California fires ranged from 287 seedlings per acre in high severity to more than 2,600 seedlings in moderate severity areas. However, Crotteau et al (2013) also found that fir species dominated conifer regeneration; this high abundance of white fir is inconsistent with forest restoration objectives to regenerate pine. Crotteau et al. (2013) also found that Ceanothus spp. dominated high severity burn areas.

In one more example, the 1992 Rainbow fire (Caprio et al 2006), located less than 20 miles from the Project, burned mixed-conifer stands similar to those above 6800 feet elevation in the Project area. After 10 years post fire high severity areas had 33 percent cover of Ceanothus spp. and less than 20 trees per acre. Trees were regenerating, particularly at low-to-moderate severity sites, with white fir being the most prevalent. Low densities of Jeffrey pine establishment were occurring in areas where high severity fire had occurred. Regeneration was lowest in areas greater than 300 feet from surviving pre-fire trees due to a limited seed source. Of particular concern were areas where large unnatural patches of overstory were killed. In these areas another fire would kill most regenerating trees and severely limit future tree establishment because no local seed source would be present.

Experience on the adjoining High Sierra Ranger District (HSRD) with post fire natural regeneration resulted in a variable response immediately following the 1994 Big Creek fire near the French and Aspen fires. Following the Big Creek fire approximately 25 percent of areas proposed for planting were found with natural conifer regeneration and 75 percent had no seedlings; this is in contrast to findings in the Douglas-fir forest of the Klamath studied by Donato (2009). Areas in the Big Creek fire with viable conifer seed produced dense thickets of seedlings; while areas with no surviving conifers or where conifer cones were damaged by fire scorch, little to no seedlings were found. These results are similar to effects reported by Collins and Roller 2013 and Caprio et al. 2006.

Figure 16. Shrubs and herbaceous species dominating areas 10 years after severe overstory mortality is Sierra Nevada mixed conifer (from Caprio et al. 2006). Common shrub species included bear clover, whitethorn, manzanita, and wild current.

Areas of high/moderate fire severity with brush/grass seed sources, sprouting species, or existing understories of brush tend to become occupied by these existing brush species following disturbance. Even with natural regeneration high and moderate severity areas will become dominated by shrub and grass or white fir and incense cedar species similar to results described in Caprio et al. 2006, Crotteau et al. 2013 and Collins and Roller 2013. Treatments that create conditions for tree growth are often needed to establish and maintain tree cover (McDonald and Fiddler 1995, McDonald and Everest 1996, McDonald and Fiddler 2010).

Need for Herbicides

Hand, mechanical and chemical (glyphosate) methods are proposed to control competing vegetation. Successful establishment of pine plantations hinges on early control of competing vegetation before competing vegetation can capture scarce resources (McDonald and Fiddler 1989). The R5-FEIS, (USDA, 1988) and Pacific Southwest Regional policy requires a determination of the essentiality of herbicides used in reforestation. The analysis examines the biological factors of each brush and grass species to determine a control tool (hand, chemical, and mechanical) to achieve the reforestation objectives. The analysis examines the literature and past experience on the SNF that characterize the effectiveness of treatments and the need for herbicides. The comparison of competing vegetation biology, available management tools, the need for control, and early intervention are aspects of a process known as Integrated Pest Management (IPM).

The French Fire resulted in extensive areas of fire killed trees and has reduced overstory tree canopy cover in the Project area. This will result in increased resources for understory shrub production. Bear clover was, and will be, a major component of the understory throughout the French Fire area. Bear clover is known for its rapid recolonization of an area following fire. Studies on the neighboring HSRD of understory Ceanothus species volume and overstory canopy cover indicate that brush production is related to both the amount of overstory tree canopy cover and the amount of understory brush volume (Kie 1985). Equations developed by Kie indicate Ceanothus brush growth will increase by 35 to 50 percent for reductions in canopy cover from 60 percent to 35 percent similar to those found in moderate, low and very low severity areas (1985). Crotteau et al. found that

surviving trees reduced the amount of brush compared to high severity areas with no trees (2013). Brush species seed readily germinate following fires. High and moderate severity areas with little or no tree cover will see bear clover and brush cover increase and dominate openings. Ceanothus species growth will increase by 200 percent in high and moderate severity patches with few trees. Increases in growth and cover of manzanita, bear clover and other brush species can be expected as a result of fire killed overstory canopy cover.

Site preparation which includes the use of herbicides and release treatments planned for the Project have proven effective in the control of competing vegetation found in fire created openings and plantations. Existing plantations within the French Fire boundaries were successfully established following site preparation treatments which included the use of herbicides to control bear clover. The French Fire created conditions suitable for the rapid reestablishment of bear clover as well as the invasion of plants that do well in disturbed sites or open canopies. Site preparation and release treatments will tend to maintain the open (low brush) condition found immediately post fire in high and moderate severity areas for 5 to 10 years. These plants that arrive following disturbance include grasses (including cheatgrass) and other noxious weeds (McDonald and Fiddler 1989, McDonald 1986, Larson and Schubert 1969, Keeley 2001). While fire effects and treatments reduce the cover of site competitors, treatments create site conditions for the dominance of conifers (McDonald and Fiddler 1995).

Bear clover was prevalent throughout the fire area prior to the fire. In most locations, bear clover covered 70 to 100 percent of the ground cover. In a dense forest, bear clover is found at low densities beneath the overstory. Bear clover can fully occupy openings. Ground disturbing activities (harvest, tractor piling, and mastication) and fire may crush or reduce above ground stems, but the rhizome type root system remains intact and can readily take advantage of increased sunlight and nutrients. Roots have been noted to extend to a depth of 6 feet or more with rhizomes extending out as far as 90 feet (McDonald, et al. 2004)(McDonald and Fiddler 1999). McDonald (1996) stated the following: “among the many widespread aggressive shrub species that negatively impact young ponderosa pine plantations in the Sierra Nevadas of California, bear clover is probably the toughest.”

The dense mass of bear clover rhizomes efficiently captures available moisture. Bear clover apparently uses much of the available soil moisture early in the spring to attain a maximum amount of photosynthesis at the expense of reduced photosynthesis and growth later in the season. Ramifications of this relationship are twofold: (1) the species apparently has efficient stomatal control, and (2) bear clover causes rapid soil depletion that limits the amount of moisture available to other species. (McDonald, et al. 2004) Tappeiner and Radosevich (1982) found that bear clover caused a rapid depletion of available soil moisture.

Bear clover foliage appears to produce growth inhibitors that reduce the likelihood of natural conifer regeneration. Conifer seed is often caught in the dense foliage of bear clover crowns and never reaches the ground. Seed that does reach the ground has difficulty penetrating the deep litter layer. Once in mineral soil, competition for site resources among the mass of bear clover roots is fierce. Seedlings rarely become established; those that do, experience poor growth. Death is almost always ascribed to competition induced drought (McDonald, et al. 2004).

A ground application using backpack sprayers of glyphosate plus surfactant would reduce the cover of both the above ground and below ground rhizomes. A review of Forest Service experience in non-chemical vegetation control (Click et al. 1988; Click et al. 1994) and local SNF experience indicates that chemical applications are the only effective way to insure reforestation objectives are met. Glyphosate has been used successfully to treat bear clover in plantations within the French Fire area. Herbicide treatments would not completely eliminate bear clover. Over time bear clover will reinvade the site.

Research indicates that effective treatments are those that kill bear clover rhizomes, and herbicides such as glyphosate are effective, while hand, fire and mechanical methods are not effective control treatments (Tappenier and Radosevich, 1982, McDonald et al. 2004, McDonald and Fiddler 2010). In local environments, treatments such as the winged subsoiler and repeated fire at the time of flowering have been suggested for control, but have not proven effective. Fire, hoeing, terracing and other machine~~s~~ methods have been used on the SNF to remove the above ground portion of bear clover; due to the rhizome type root system sprouting of

plants occurred soon after treatment. Terracing done during site preparation prior to planting within the fire area was not effective. Sprouts quickly reinvaded these treated areas. Survival of planted seedlings was well below desired stocking levels.

Herbicides application has proven the only effective means to control bear clover on the SNF. These results agree with reforestation research that indicates that after three years, only 13 percent of the conifers planted were alive in a study area with bear clover cover of less than 40 percent (Tappenier and Radosevich, 1982). This contrasts with 71 percent survival in areas with temporary control of bear clover. Over a 19-year span, only nine percent of the trees planted in an area with no vegetation control survived. Growth of the surviving seedlings is also impacted. In the same study, after 19 years surviving pines in the bear clover averaged 5.1 feet in height whereas the average height in the areas with temporary control of bear clover averaged 18.5 feet. The Tappernier and Radosevich study projected a 75% reduction in growth due to bear clover competition at 50 years. A review of bear clover control measures by McDonald et al. (2004) indicate that treatments that kill bear clover rhizomes such as herbicides are the only effective control measure, while other treatments have been failures.

The single strongest factor affecting planted tree growth in the detailed long-term soil productivity experiment was understory brush cover (Powers et al. 2004). In the Sierra Nevada, where summer drought is common, planted tree productivity averaged more than three times higher in the absence of understory vegetation (Powers et al. 2004). Successful establishment of pine plantations hinges on early control of competing vegetation before competing vegetation can capture scare resources (McDonald and Fiddler 1989). McDonald and Fiddler (2010) reviewed 60 competing vegetation control studies respectively across the forested areas of California. Key findings of McDonald and Fiddler (2010) reviews are that grubbing (hand release) is not feasible in plant communities that arise from sprouts or rhizomes. In addition, McDonald and Fiddler found that with reliance on manual methods, grazing or mechanical methods result in variable structures dominated by shade tolerant species (white fir and incense cedar) and lower vegetation diversity.

Plant diversity tends to be higher in areas released for conifers than in those dominated by shrub communities. Bear clover tends to quickly capture the site following disturbance (McDonald, et al. 2004). Vegetation species diversity tends to be limited in bear clover dominated stands. Treatment of bear clover would result in an increase in plant species diversity. McDonald and Fiddler 2010 found that in a comparison of vegetation development after 10 years in the three differing communities manipulated by several release treatments provides two important points: (1) an increasing shrub density often causes fewer species in the plantation and a broader range in foliar cover and height than in other communities, even if the range in number of plants per acre is lower; and (2) whatever the plant community, a large range in number of species per acre is present and their range in density is large. Zhang et al. 2008 also reported higher plant diversity in planted and released areas than in untreated areas of the Fountain fire.

The long history of reforestation on the SNF and research that has examined the growth of conifers with and without brush competition suggests that the direct and indirect effect of Alternative 2, 4 and 5 on bear clover, Ceanothus and manzanita species would be to free site resources for the growth of conifers. Based on the morphological characteristics that promote sprouting, the history of ineffectiveness of hand and mechanical control of bear clover; the large body of research that indicates that bear clover is a strong competitor with conifers for site resources—herbicides are essential for the control of bear clover.The large body of research further indicates that manzanita and Ceanothus are strong competitors with conifers. Herbicide treatments are primarily planned for the control of bear clover and brush species present prior to planting. Release herbicide treatments would be undertaken in those areas where the initial herbicide application was unsuccessful or planting was accomplished prior to the reoccupation of the site by bear clover. Competing brush would be treated at the same time as the bear clover. Subsequent release treatments for brush competition would be accomplished by hand. Bear clover is a very strong competitor with conifers for site resources. The use of herbicides is essential for control of bear clover and mixed in brush species.

Although bear clover will present the greatest obstacle to reforestation efforts within the French Fire area, other brush species found in the Project area will also affect the survival and growth of conifer seedlings. The mode of brush regeneration and the species alter the effectiveness of proposed treatments. The specific regeneration modes, conifer response, and effectiveness of treatments are discussed in the Vegetation Specialist Report found in the Project record.

Conifers

Using site preparation, planting, and release treatments, approximately 3,000 acres of regeneration are proposed. Due to the severity of the French Fire, the continuing exceptional drought conditions and high populations of bark beetles nearby, few remnant larger trees will be present within proposed treatment units. Planted and naturally established seedlings and scattered trees would eventually grow large enough to shade out many of the competing brush and grass species in approximately 40 to 50 years or more. Seedlings planted within the fire area would introduce genetic variation by planting seedlings grown from seed collected from within the seed zone as well as blister rust resistant sugar pine. Stand development from early brush dominance to conifer dominance would be greatly accelerated over natural stand succession rates.

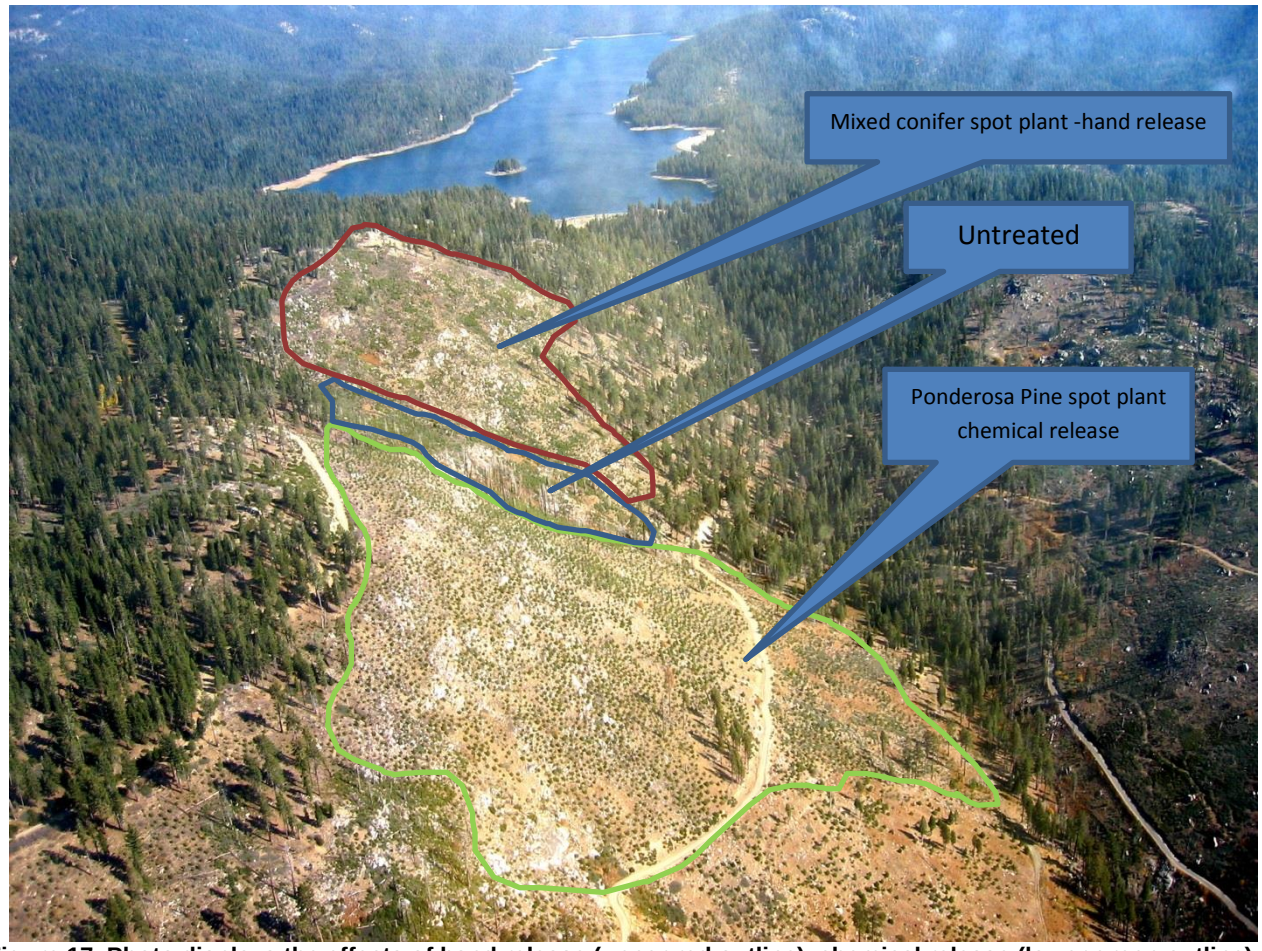


Figure 17. Photo displays the effects of hand release (upper red outline), chemical release (lower green outline) and no treatment (middle blue outline) 7 years after the Big Creek fire.

In figure 17 above, the dark green areas (inside red and blue outline) are Ceanothus and green leaf manzanita approximately 30 and 70 percent cover, respectively. Inside the red and blue boundaries conifer seedlings are under brush and cannot be seen in the hand release or untreated areas. White areas within these boundaries are rock. Light green (individual plants inside green outline) are five year old planted and natural conifers with less than 20 percent cover.

Fire Severity

Recent non-peer reviewed and published articles suggest high-intensity, or stand-transforming, fire creates ecologically-vital "snag forest habitat", which is rich with large snags, large downed logs, dense pockets of natural conifer regeneration, patches of native shrub habitat, or "montane chaparral", and large live trees (Hanson 2010). Literature indicates that high severity fire was more prevalent and that most western ponderosa pine and mixed conifers forests appear to have been characterized by mixed-severity fire that included ecologically noteworthy amounts of weather-driven, high-severity fire; as well as literature that indicates that high – intensity (high severity fire) is lacking and rather than a threat to Sierra Nevada Forests is a benefit and may not be increasing (Odion and Hanson 2009, Hanson and Odion 2014).

However, research indicates that there is no evidence that high-severity burned areas are deficient in the entire Sierra Nevada or the southern Sierra Nevada region (Miller et al. 2009, Miller et al. 2012). In addition, science

articles indicate that research used by Hanson (2010) to support the case for more high severity fire are erroneous and deficient and do not support the conclusions for more high severity fire (Spies *et al.* 2009).

Furthermore, methodologies used by Hanson and Odion (2014) to determine historical fire severity and extent have been used by other research articles concerning dry western forests (William and Baker 2012). The results by Hanson and Odion (2014) rely on assumptions and inferences of data that are not supported by the data or go beyond the information contained in the data. Hanson and Odion (2014) and Williams and Baker (2012) both rely on existing forest structure to determine past fire severity and extent; these articles also rely on unique forest structural definitions to quantify changes in forest structure and heterogeneity over time. Fule et al. (2013) identified "important errors" in basic assumption and methods in William and Baker (2012) that are also present in Hanson and Odion (2014): the use of tree size distributions to reconstruct past fire severity and extent is not supported by empirical age–size relationships nor by studies that directly quantified disturbance history dry western forests; Fuel et al. (2013) note that while William and Baker (2012) asserted surprising' heterogeneity in their reconstructions of stand density and species composition, their data are not substantially different from many previous studies which reached very different conclusions about subsequent forest and fire behavior changes.

Miller et al. 2012 summarized the mischaracterizations of the fire severity in the Sierra Nevada range by papers used in Hanson 2010:

> In contrast, some researchers have recently suggested that large contemporary fires within the study area, which exhibited very large (1000–5000 ha) high-severity patches, fall within the natural range of variation, and therefore are typical of the historic fire regime (Odion and Hanson 2006). However, variation of fire regime characteristics is better described by traditional statistics (i.e., mean, mode and standard deviation) rather than maxima, because maxima by definition represent rare events (Burt and Barber 1996, Landres et al. 1999, Sugihara and Barbour 2006). It is much more likely that fire effects seen in the contemporary fires in the Odion and Hanson (2006) study were actually rare historically (Perry et al. 2011). For example, for the three fires analyzed by Odion and Hanson (2006) mean high-severity patch size was more than twice as large as the mean high-severity patch size in Yosemite fires from 1984–2009 (9.5 ha vs. 4.2 ha), and patches larger than 100 ha occurred more than twice as often (1.49% vs. 0.69%). Any increase in the distribution of large patch size and occurrence, both in time and space, in comparison to historical conditions has important implications to forest recovery and species habitat (Pickett and White 1985, Roberts et al. 2008, Roberts et al. 2011). Large proportions of two of the three fires Odion and Hanson studied occurred on the westside (1/3 and 2/3), but mean percentages of high severity by forest type in the Odion and Hanson study (mixed conifer = 25.8%, yellow pine = 34.2%, and red fir = 13.4%) were more representative of percentages of Cascade-Modoc and eastside fires that were more than two times higher and significantly different than percentages in Yosemite fires (Table 4 and Fig. 2). Historic regime characteristics for the westside may have been different from Cascade-Modoc and eastside due to the differences in precipitation patterns, but we have no analog for Yosemite in those regions for comparison. Regardless, current eastside fire regime characteristics are likely not representative of "historic" conditions that result in old-forest conditions in frequent fire dry forests (Smith 1991, Stephens et al. 2008, Larson and Churchill 2012).

Current science indicates that the total area of high severity burned forest in the Sierra Nevada is not lower than historic reference conditions (Safford 2010, Mallek et al. 2013) and the size of high severity burned patches has substantially increased (Miller and Safford 2008, and Miller *et al.* 2009, Miller and Safford 2012). Lutz et al., found in a study conducted in Yosemite National Park, that the proportion of area burned at higher severities increased with annual area burned (2009). Recent findings in northwest California (Miller et al. 2012) differ from results for the Sierra Nevada and adjacent southern Cascades, where an increasing trend in the percentage of high-severity fire for ponderosa pine and mixed conifer forest types has been reported (Miller et al. 2009a).

However, biodiversity of plants, fungi, and wildlife is not greatest in high-severity burned patches, but is maximized in diverse landscapes that incorporate a matrix of burn severities, forest seral stages (including

managed forests), and most importantly, habitat diversity (Graber 1996, Wayman and North 2007, Meyer *et al.* 2008). Other research clearly indicates that high severity fire threatens Pacific fisher and California spotted owl habitat (Verner *et al.* 1992, Spencer *et al.* 2008). Without mechanical and prescribed fire treatments Pacific fisher habitat will become increasingly reduced and threaten populations (Spencer *et al.* 2008). Increasing the resistance to change from wildfire and bark beetle attack moves closer to addressing project needs and maintains important structures for Pacific fisher and California spotted owls following these disturbances (North *et al.* 2009).

3.6.1.1. Indicators

Indicator 1: Changes in forest structure related to fire severity

Fire severity provides the measure of how much the fire changed vegetation conditions across the Project area. The fire killed and injured trees and shrubs. Fire mortality results in changed forest structure and habitat. The changes to forest structures are often delayed three to five years (Smith and Cluck 2011). The severity in forest structure changes the dominance of trees versus brush. Treatments can alter brush cover. Brush cover effects conifer reforestation and subsequent conifer forest structure. Forest structure changes are measured in basal area (BA) loss. Treatments have the potential to change post fire forest structure and resulting habitat. Changes in habitat due to treatments are accounted through changes in California Wildlife Habitat Relationships (CWHR) and snag habitat. The potential for increased severity and secondary fire effects are indicated by drought and bark beetle response. Secondary fire affects result in more snag habitat. Treatments that recover fire-injured and insect/drought killed trees can change the forest snag habitat.

Basal Area Loss

Basal area is a stand forest measure that helps describe forest structure, habitat, tree density, and potential for bark beetle attack. Basal area is used in forest management to describe habitat characteristics for wildlife; a basal area of 185 square feet is the average condition for California spotted owl nesting stands (Verner et al. 1992). Fire severity is categorized by how much tree mortality (basal area loss) occurs. Higher the severity and the accompanying higher amounts of tree mortality reflect more changes in forest structure and habitat. The analysis classifies fire severity based upon the percent of basal area caused tree mortality using both severity mapping and plot data. This indicator is grouped into two broad categories of severity: high and moderate; and low and very low.

Changes in CWHR Type

Vegetation within the Project is described using the CWHR model. This model classifies forest conditions by vegetation type, quadratic mean diameter, and canopy cover as a predictive model for various mammals, birds, and amphibian species in California (Mayer & Laudenslayer 1988). Furthermore, it is useful in determining the distribution and abundancy of forest structure in project areas.

Use of the CWHR model allows for consistent analysis of effects on forest vegetation and associated wildlife habitat. The CWHR vegetation typing and fire severity (Miller et al. 2009; Miller and Thode 2007) are used to measure the effects of alternatives on landscape structure and diversity. The analysis uses CWHR in the following manner:

- CWHR describes live tree structure,
- The French Fire resulted in the mortality and remaining live tree structure,
- Dead tree (fire-killed) structure is composed of pre-fire CWHR structure,
- The pre-fire CWHR types represent the type of post-fire snag structure (e.g. “PPN” means pine snags dominate versus “MHW” where oak snags dominate),
- Fire severity is categorized into four classes: 1) low severity (0-25% basal area loss), 2) Moderate to low severity (25-50% basal area loss), 3) moderate to high severity (50-75% basal area loss), and 4) high severity (≥75% basal area loss),

- Fire severity killed both large and small diameter trees that change the pre-fire forest structure,
- The analysis uses pre-fire CWHR and fire severity acres to measure the changes in snag habitat by harvest of post-fire snag structure,
- Live post-fire CWHR acreage is used in the analysis to display the effects of treatments to live forest structure.

CWHR vegetation type, size class, and density compose the habitat classification system and are used to display the distribution of forest structure. In addition, use of this system allows for the consistent analysis of effects on forest structure and wildlife habitat. The major CWHR types found in the French Fire area include, but are not limited to: barren/montane chaparral, montane hardwood, montane hardwood-conifer, ponderosa pine, and Sierra mixed-conifer.

Size classes 0-2 are indicative of young trees, habitat best described as dominated by seedlings and saplings (Table 20). Size class 2 typically represents plantations less than 20 years old. Size class 3 describes pole size trees (6-11 inches dbh) often indicative of 20 to 50 year old plantations. Larger size classes combined with moderate/dense canopy cover are interpreted, by some, as “old forest” or “mature closed canopy forest” habitat. “Old forest” habitat should have a number of larger diameter trees (40 inches dbh plus). Large size classes may take 150 to more than 200 years (varies by site quality) to develop the traits of “old forest” conditions (Meyer 1938, Dunning and Reineke 1933). Density of forest cover is expressed in terms of tree canopy cover (Table 23). Dense forest cover can develop in as little as 10 years when dominated by small trees or take hundreds of years when dominated by larger trees. Multistory forest provides variable tree structure when both large and medium trees co-exist with saplings and seedlings. These multistory stands develop in a variety of ways, yet the large tree component takes the longest to develop. Multistory and dense large tree classes provide habitat for a variety of species including, but not limited to: fisher, California spotted owl, and pine marten that use “old forest” habitat.

Table 22. CWHR class size.

	CWHR Tree Size Classes					
	1	**2**	**3**	**4**	**5**	**6**
Diameter Range	<1” dbh	1-6” dbh	6-11” dbh	11-24”dbh	>24” dbh	multistory
Description	Seedlings	Sapling	Pole tree	Small tree	Medium/large tree	Two distinct tree layers

Table 23. Description of CWHR density and canopy cover.

	CWHR Tree Density Classes				
	S	**P**	**M**	**D**	**“Blank”**
Canopy Cover	10-24%	25-39%	40-59%	>60%	<10%
Description	Sparse cover	Open cover	Moderate	Dense cover	No cover, but forest

The display of pre-fire CWHR categories provides information on the quality of post-fire snag habitat.

The analysis uses post-fire plots and remotely sensed imagery to determine changes in CWHR size and density. Acres of CWHR size and canopy density change are displayed. The analysis also displays the changes total tree canopy cover and dbh represented in plot data.

Standard and guideline 14 of the SNFPA ROD indicates that post fire restoration projects: “generally do not conduct salvage harvest in at least 10 percent of the total area affected by fire”. These areas of no harvest

provide intact snag habitat that provides dead tree structures for wildlife. Percent of total unharvest habitat are used to compare against this standard and guideline.

High Severity Patch Size

The analysis examines the size of fire severity patches and the potential for seed dispersal and natural reforestation. High severity patch size provides scale for the severity of fire affects and subsequent effects from actions to reforest these patches and the no action alternative that allows secondary succession to proceed. Larger patches can create openings larger than available seed from neighboring surviving conifers can reach (Bonnet 2005). Patch size also provides a context relative to forests with functioning fire processes. The analysis compares the high severity patch sizes found in functioning forests to high severity patches found in the French Fire. The analysis uses high severity patch sizes over 25 acres as an indicator for relative severity and a 300 foot distance as the potential for adequate seed dispersal.

Insects and Drought

Fire kills as well as injures trees. These injuries to stems, branches, needles, leaves, roots, and buds reduce the ability of trees to produce energy through photosynthesis. Drought further weakens trees by reducing the amount or soil moisture available for tree growth and defensive mechanisms against bark beetle attack. The analysis examines the combined effects of fire, drought, live tree density and insects. The analysis identifies the potential effects of these combined factors on insect mortality and the potential removal of these fire weakened and insect killed trees.

Indicator 2: Number of Trees per Acre and Basal Area Live and Dead

The analysis compares the post fire condition of snags (dead trees) and live trees to the amount remaining after proposed harvest. Trees per acre and basal area are used to describe the recovery of tree density, forest structure and habitat.

Basal area per acre measures the tree stem area in square feet at dbh occupying an acre. Basal area of snags provides an indication of the severity of fire effects, but also the amount of black-backed wood pecker available post fire. Higher snag density provides for smaller and more productive black-backed woodpecker home ranges habitat (Otto 2014).

In areas dominated by ponderosa pine and mixed conifer forest types, >150 square feet of basal area would be considered a high live tree basal area with trees subject to insect mortality and health issues (Sartwell 1975); while acres with less than 100 to 115 square feet per acre would be poorly occupied by trees and likely dominated by brush (Meyer 1938). In addition, basal area provides a threshold related to the potential for insect attack. Another study shows ponderosa pine forests with less than 120 square feet per acre are at relatively lower risk to bark beetle attack (Cochran and Barret 1999). The area of low and very low fire severity with relatively high post fire tree basal area will be more prone to delayed bark beetle, fire effects and drought induced mortality (Cluck 2014). Tree size measured in inches at dbh is related to both basal area and trees per acre. Given a basal area per square feet, more trees per acre indicate smaller trees. Tree size is used to compare the direct/indirect effects on the numbers of snags and live trees by dbh.

Basal area of live trees is affected by growth of surviving trees. Basal area is important because it indicates how trees dominate a stand, potential for bark beetle attack, and habitat structure. The accumulation of basal area over time along with tree numbers indicates how growth and mortality affect tree dominance. Relative high amounts of basal area over 170 square feet per acre indicate a continued susceptibility for pine bark beetle attack. Relatively high amounts of live tree basal area provide habitat for “old forest” dependent species, while high amounts of dead tree (snags) basal area meet nesting, roosting, or denning needs for cavity nesting species such as the black-backed woodpecker as well as are potential hazard to forest workers and the public.

The analysis displays estimated number of snags created by the French Fire and the number proposed for removal for alternative 2 (refer to Wildlife BE, page 19-20).

Indicator 3: Hazard Tree Removal

The analysis compares the acres of hazard tree removal and the number of hazard trees removed with each alternative. Hazard tree removal has the potential to change snag habitat. The acres of hazard tree removal and the number of hazard trees removed are compared between alternatives. In addition, the analysis compares the changes in dead and live trees removed by hazard tree removal.

Indicator 4: Conifer reforestation, bear clover and brush

The influence of treatments, bear clover, brush and grass on tree survival and growth

The analysis uses brush cover to describe the effects of bear clover and brush on reestablishment of conifer stands. Brush cover is the percent of an acre occupied by bear clover/brush foliage. Bear clover/brush cover also effects the survival and growth of conifers both planted and naturally established. Studies recommend control of competing brush before reaching densities of 10,000 cubic feet per acre or brush canopy cover greater than 20 percent on high sites and 10 percent on low sites (Fiske 1981)(McDonald and Fiddler 1989). The 10,000 cubic feet/acre can be visualized as brush one foot high covering approximately one fourth of the area in a stand. Competing vegetation is compared against this standard, past experience and effectiveness of treatments.

The SNF has identified guidelines for successful regeneration of between 125 to 200 (depending on site quality) well distributed seedlings or saplings per acre over 90 percent of a stand after five years (USDA, FS, R-5 FSH. 2409.26b, 1991). Forest stands that fall below this level indicate poor stocking; while forest stands above this tree density indicate stands with the potential for high inter-tree competition, reduced tree vigor, and tree growth.

As trees grow and get larger they provide different habitat and structure. The faster trees increase in size the more quickly they become habitat for species reliant on “old forest” habitat. The analysis compares the change in brush cover and tree size through time for managed verses untreated areas.

3.6.2. Environmental Consequences

Direct effects on vegetation are caused by the removal of fire-affected trees, felling of small trees, slash piling, mastication, slash crushing, pile burning, jack pot burning, brush cutting, and chemical application. The direct effects occur at the same time and place as the proposed treatments.

Indirect effects are caused by treatments and are later in time, but are still reasonably foreseeable. Indirect effects result from growth induced effects related to tree and brush growth rate, tree vigor, and fire behavior. Conifer, oak, and brush establishment and subsequent growth have indirect effects on habitat (CWHR), tree size, canopy cover and achieving reforestation objectives.

Cumulative impact is the impact on vegetation which results from the incremental impact of tree removal, tree establishment, brush cutting, slash piling, mastication, prescribed fire and chemical application when added to other past, present, and reasonably foreseeable actions that effect vegetation structure, growth, or vigor.

3.6.3. Alternative 1 (No Action)

Direct and Indirect Effects

Indicator 1: Changes in Forest Structure Related to Fire Severity

Because the No Action alternative implements no activities there are no direct effects on any indicators.

Since Alternative 1 does not implement specific activities to reduce live tree canopy cover or remove fire-affected trees, unplanned events play the greatest role in controlling canopy cover. Indirect effects would occur as a result of secondary succession, growth, insect mortality, bark beetle mortality or unplanned fire events. Only unplanned events result in conifer regeneration (secondary succession) to achieve the desired "old forest" conditions under this alternative.

High and moderate fire severity patches-RAVG mapping delineated 53 percent of the fire area with basal area mortality above 50 percent. However, plot data indicates basal area mortality within the moderate to low burn severity areas experienced basal area mortality of 66 percent. This places an additional 15 percent of the fire area into the moderate to high classification (50 percent and greater mortality) for a total of 68 percent of the French Fire area with 50 percent or greater basal area mortality. High and moderate fire severity patches would change as a result of secondary succession and bark beetle mortality.

Re-vegetation of severely-disturbed forests often is very slow and unpredictable because of complex interactions among propagules (e.g. seed; stump, rhizome, and root sprouting) as well as site and climatic conditions (Kozlowski 2002). While conifers, oaks and brush can survive or establish after disturbances such as fire or harvest, the pattern of response is often dictated by the available seed, high severity patch size, and conditions suitable for tree growth (soil moisture and bare soil) and treatments (McDonald and Fiddler 1995, Bonnet et al. 2005).

These high and moderate severity areas following the fire will be dominated by bear clover, brush seedlings, brush sprouts, grasses and forbs. This combination of brush and grass is classified as montane chaparral (previously conifer dominated) or mixed chaparral (previously brush dominated). Montane chaparral high severity areas in nearby fire areas from 1939 and 1994 remain montane chaparral for 20 years or more.

Several of the moderate to high severity burn areas are between one and two miles long and ½ mile wide. Due to a lack of seed trees, heavy bear clover competition, and the likelihood of long, hot, dry summers continuing, little natural regeneration would take place. McGinnis, et al. 2010, stated that shrub dominance could last a century or more in fire areas where conifer seed sources are distant or frequent fires kill immature conifers. McGinnis further stated shade tolerant firs and other species may eventually dominate.

However, due to a lack of surviving trees to provide a seed source, heavy bear clover and brush competition, and likely continuing drought, establishment of sufficient young conifer seedlings through natural regeneration is unlikely. McDonald, et al. (2004) noted that without treatment of bear clover even in planted areas ponderosa pine seedling survival was less than 20% after the first year. Tappeiner and Radosevich noted only 13% survival at year three in their 1982 study. For those seedlings that do survive, bear clover, brush and scattered dense conifer clumps delay and slow conifer growth by more than two times (McDonald and Fiddler 2010). Tappeiner and Radosevich (1982) projected a 75% reduction in wood production by age 50 with uncontrolled bear clover competition.

Along the edges of high and moderate severity patches the CWHR type would very slowly begin to shift from montane chaparral to conifer types (primarily incense cedar and white fir). At lower elevations CWHR types would shift to montane hardwood types as sprouting oaks grow to tree size and continue to dominate. Areas previously dominated by shrubs and oaks would be dominated by shrubs and oak sprouts (mixed chaparral). At mid to higher elevations (4,500 to 6,500 feet) fir would encroach and shift species to white fir/incense cedar or fir dominated mixed conifer.

This very slow return of conifer dominance would greatly delay the return of moderate and dense tree cover associated with spotted owls and fisher dependent on "old forest" type habitat. "Old forest" habitat is characterized by small (11 inches to 24 inches dbh, CWHR 4) and medium to large trees (>24 inches dbh, CWHR 5) and moderate and dense conifer canopy cover (canopy cover greater than 40 percent or "M"). Plantations within the fire area previously treated with herbicides reached 11 inches dbh after about 30 to 40 years. Experience on the SNF and research indicate that establishment could be delayed for an additional 50 or more years due to bear clover and brush. A 50 year delay in establishment when added to a 40 to 50 year growth period would indicate a period of 90 to 100 years to return stands to a "4M" CWHR structure. The

effect of bear clover, brush and patchy dense conifer clumps found in high and moderate severity areas could conservatively result in stands taking 125 to 150 years to return to pre-fire “old forest” conditions “4M” structure depending on site conditions.

Competition from bear clover and brush will result in surviving seedlings remaining susceptible to loss due to insects (Pine Reproduction Weevil, Ipps, etc) and/or drought (McDonald and Fiddler, 1989) for many more years. McGinnis, et al. (2010) noted that due to the small height and diameter of planted seedlings they would be prone to loss in a wildfire for at least the first twenty years following planting. The potential for conifer loss due to wildfire will be substantially longer in naturally regenerated stands. The small diameters and heights of naturally regenerated trees that become established along with extensive bear clover and brush competition will leave these stands prone to loss due to wildfire until they obtain larger diameters many decades in the future.

Within moderate severity areas fire affects, drought and insect attacks would further reduce canopy cover for the next three to five years. This continued mortality would not affect the CWHR type, size or density since so few trees survived the fire.

Within low and very low severity areas tree canopy cover will continue to drop for 4 to 7 years as fire effects and drought weaken trees and bark beetle mortality continues to kill trees. CWHR size and density classes will decrease within portions of stands. After 4 to 7 years canopy cover will begin to increase as surviving trees reoccupy space of fire-affect trees. After 8 to 12 years CWHR canopy density will increase in low and very low severity areas. As a result of growth in conifer dominated areas CWHR size and density classes will shift to larger trees and denser canopy. Post fire size and canopy classes 4M, 4D, 5M, 5D combined, where present, will increase from a post fire approximately 45 percent tree canopy cover to approximately 55 percent tree canopy cover after 30 years. Post fire size and canopy classes 4P, 4S, 5P, 5Scombined, where present, will increase from a post fire approximately 30 percent tree canopy cover to approximately 40 percent after 30 years. Low and very low severity areas continue to provide “old forest” habitat for species like spotted owl and pacific fisher.

Indicator 2: Number of Trees per Acre and Basal Area Live and Dead

Trees and Snags per Acre

High and moderate severity fire reduced the number of surviving trees. Large tree mortality (greater than 30 inches dbh) is of specific importance because of the time necessary to replace large tree structures. Recovery of forest structures, especially the number of large trees, requires time to develop and a period free of stand replacing events. The no action alternative maintains trees and snags present after the fire. The number of trees and snags change as a result of seedling establishment, tree growth, snag decay, additional mortality and snag fall rates.

Conifer seedling establishment (especially pine) post fire is variable and conditional upon soil moisture, bare soil, bear clover and brush competition and seed availability. These conditions for the reforestation of pine are often lacking post fire (Bonnet et al. 2005, Caprio et al. 2006, and Collins and Roller 2013). In contrast the low and very low fire severity with surviving conifers would increase in tree numbers and basal area. In the approximately 2,999 acres of high (75 percent basal area loss) severity conifer typed patches where patch size exceeds 25 acres, seedling establishment would be greatly delayed due to both the dominance of bear clover and brush species and the distance of many areas from seed. This delay would range from 20 to 70 years or longer depending on the distance from the edge of high severity patches and the number of surviving conifers.

In moderate severity patches seedling establishment would be delayed due to bear clover/brush dominance alone. In other moderate severity areas with surviving conifers and little bear clover, conifer establishment may result in dense thickets of conifers that can exceed 1,000 trees per acre. Trees would be poorly distributed with less than 15 percent of the high and moderate areas with conifer trees. Trees per acre would fall below the minimum stocking levels in the SNF LRMP S&G 101 (page 4-19).

Figure 18. Photos displays a typical untreated poderosa pine high severity area post fires (left) and 10 years later (right) in the Big Creek Fire in 1994. Note the heavy cover of brush and live oak and the loss of most snags.

Although little bear clover was present , the Big Creek fire, near the Project area and found on similar forest types and elevation range, serves as an example of vegetation fire response for untreated as well as treated sites. The Big Creek Project retained 40 five-acre areas untreated across different burn severities within the 5,600 acre fire. High severity areas experienced more than 95 percent mortality. At 10 years post fire few conifers were evident within the high severity plots; while most or all snags had fallen. Trees that did become established were found among dense brush cover (greater than 50 percent) or in dense tree clumps (greater than 500 trees per acre). After 20 years, conifers were found in most plots, but were equal to or below brush height (3 to 6 feet tall). Tree-numbers varied greatly from a few dozen to more than 500 per acre. Oaks were evident in lower elevations and fir dominated upper elevations.

Low and very low severity areas have snag basal areas that are high compared to historical levels or LRMP guidelines, but structures are relatively less flammable and consistent with LRMP desired conditions. Portions of conifer dominated stands in low and very low severity areas continue to provide habitat for “old forest” dependent species.

Snags, dead limbs and needles also accumulate on the forest floor in the first 10 years. (Ritchie et al. 2013). However, Donato et al. found that 2 years after fire surface fuel loads from snags have not yet accumulated (2006). The inevitable accumulation of fuels in a short time frame across 7,967 acres of previously conifer typed areas present a hazard to neighboring stands that will persist for decades (Peterson et al. 2009, Skinner and Weatherspoon 1997). This effect however changes with time following the burn; burns initially present barriers to new fires. As fuel and brush age they become more flammable. Studies of short interval burning indicate that reburns maintain high shrub cover and reinitiate dense conifer establishment (Donato et al. 2009). Other studies from Oregon would indicate that repeat fires with or without salvage serve to kill high numbers of seedlings and promote shrub dominance (Thomas and Spies 2010). Shade tolerant species tend to dominate naturally regenerated stands in brush dominated stands. Planted areas with no fuels treatments greatly increase fire severity and these areas are also greatly affected by fuels in neighboring stands (Skinner and Weatherspoon

1997). However, stands that accelerate growth and achieve larger tree size more quickly allow for much earlier applications of fire.

High and moderate severity patches dominated by snags, bear clover, brush, and dense thickets of incense-cedar and white fir provide conditions for slow conifer growth and high fuels loads (Stalter 2015 Fuels Report) over a large landscape (7,315 acres - RAVG 50% and greater basal area loss). These persistent brush conditions and high fuel loads do not favor the growth of pine species appropriate for the project area. In contrast the low and very low severity areas are characterized by lower fuel loads and more intact conifer forest structure.

The SNF LRMP standard is 4 snags per acre greater than 15 inches dbh for ponderosa pine and mixed-conifer forest types. Frequent fire regime forests, such as those found in the Project retain approximately 2 to 4 snags per acre greater than 15 inches dbh (Safford 2012). Ponderosa pine and mixed-conifer forest types contain approximately 25 snags per acre following the French Fire; this is reduced through decay and breakage to approximately 3 snags per acre after 30 years assuming no other future unplanned disturbances (fire or insect mortality). Figure 18 displays changes to snags standing in untreated areas in the nearby Big Creek fire over 10 years.

Although there are many existing snags in the Project area, many are expected to be down within the first ten years after the fire within higher severity burned areas. Russell (2006) shows that ponderosa pine has a snag longevity of seven to ten years. Ritchie et al. 2013 found that most snags fell within 8 years after being killed by fire and that 40 percent of trees larger than 11 inches dbh were standing by year eight. These studies along with a study by Chambers and Mast (2005) suggest an increase in burned snag fall rate after three to eight years.

Shade tolerant species tend to dominate naturally regenerated stands in brush dominated stands (McGinnis, et al. 2010).

High numbers of snags would remain within the Project area for up to 10 years. Alternative 1 retains an average of approximately 25 snags per acre; as a result it meets the LRMP objectives for snags per acre.

Basal Area

Live tree basal area would be slow to accumulate in high and moderate areas. The fire killed more than 93 percent of the basal area in high severity conifer dominated areas on average and more than 77 percent in moderate to high areas on average. The moderate to low severity conifer dominated fire areas sustained 76 percent basal area mortality. As a result additional basal area growth is dependent on the reestablishment of new trees. Basal area in conifer dominated high severity burn areas was 8 square feet found in scattered clumps of survivors. In the moderate to high areas post fire it was 22 square feet.

Basal area increases as conifers seedlings grow, but basal area increases slowly. This slow accumulation of basal area is due to both high levels of shrub competition and variable amount distribution of conifer regeneration. Tree basal area less than 100 square feet per acre indicates that shrubs rather than trees dominate areas of high and moderate mortality after 30 years.

In the moderate to low severity areas remaining basal area is less than 39 square feet. Remaining basal area in the low to very low severity areas was measured at 94 square feet per acre. Changes in basal area in low and very low severity areas are dominated by increased growth of surviving trees. The fire killed approximately 42 percent of the basal area in low and very low severity areas in some areas. The resulting drop in tree density will likely improve tree growth and vigor of surviving trees. This reduction in basal area has the indirect effect of reducing the potential for bark beetle attack in those areas. However, dense pockets of trees with high basal area survived the fire and continue to be subject to insect attack. Live tree basal area on the average increases from 120 square feet per acre to approximately 160 square feet over 30 years.

Snag basal area is high post fire and drops as a result of decay and breakage. Smaller trees with less basal area fall early in the first decade following fire. Larger trees because of their size and slower decay rates persist longer.

Indicator 3: Hazard Tree Removal

The indirect effect of Alternative 1 is continued dead and hazardous trees along roads resulting in unsafe conditions for forest users, contractors and Forest Service employees. The persistence of dead trees along roads results in continued tree decay and eventual breakage. Hazardous tree conditions would abate with time as trees fall. Larger trees would persist and present ongoing unsafe travel conditions. Hazardous trees would pose a serious threat to all road users for at least 30 years.

Alternative 1 does not meet the purpose and need to provide for safe travel ways.

Post fire changes in vegetation Twenty Years:1994 to 2014	Big Creek fire near the French Fire burned in August of 1994
	1994 – **No Treatment** -High severity fire effects in ponderosa pine forest type following the Big Creek fire 1994. Fire killed 100% shrubs and trees. The mountains in the background provide a reference in each photo. CWHR type = Montane Chaparral
	2004-**No Treatment** -ten years following the fire shrubs dominate. Ponderosa pine and oak saplings are found intermixed with the 3 to 4 foot shrubs. Conifer trees are scattered. Conifers range in size from 1 foot to 4 feet and < 25 per acre. CWHR type = Montane Chaparral
	2014-**No Treatment** - twenty years post fire conifer trees are scattered mixed with dense shrubs >70% cover. Conifers are 4 to 7 feet tall, 1 to 3 inches dbh, and white leaf manzanita is 3 to 7 feet tall. CWHR type = Montane Chaparral
	2014 -**Managed** plantation on similar site established from natural/planted seedlings. Three hand releases (1996, 1998, and 2008) of competing shrubs. Conifers 10 to 25 feet tall and 3 to 8 inches dbh and 200 trees per acre. White leaf manzanita 2 to 3 feet tall 30% cover. CWHR type = ponderosa pine 2M and 2P

Figure 19. Typical succession of untreated vegetation over 20 years in conifer types post fire in the Big Creek Fire.

Indicator 4: Conifer reforestation, bear clover, and brush

High and moderate severity patches are not reforested under the No Action alternative. Episodic events and conditions such as seed dispersal, bare soil, soil moisture, and low brush competition must coincide to result in conifer reestablishment and survival (Bonnet et al. 2005). No planting of fire created openings or damaged plantations would occur. Reforestation would rely on secondary succession to reforest following the French Fire. The French Fire experienced some very large areas of high and moderate to high severity patches (Figure 19). Some are 1 to 2 miles long by ½ mile wide. Due to the high burn severity of the fire combined with continued exceptional drought and high bark beetle populations, potential seed sources for natural regeneration

are very scarce. High and moderate severity areas would likely continue to be dominated by bear clover and brush similar to untreated control stands examined in research (McDonald and Fiddler 1995). McDonald and Fiddler (1995) found that Sierra Nevada forest areas dominated by brush species required treatment to return conifer dominance. In another study, McDonald and Fiddler (1997) found that areas that lacked treatment to reduce manzanita or ceanothus had changes in the dominance of brush species through time, but brush continued to dominate and increased in dominance over 31 years (see Figure 20). Literature indicates that high and moderate severity openings within the French Fire are prone to be dominated by a complex of brush species (bear clover, whitethorn, deer brush, and manzanita), incense cedar and fir species. As time passes these large fire created openings will become filled with bear clover, dense thickets of brush and scattered thickets of conifer regeneration. Additional fires may serve to maintain permanent brush cover in areas of unnaturally large openings.

Fire injured plantations (those created before the French Fire) would see bear clover, brush volume and cover increase over the analysis period. Planted seedlings and samplings would slow in height and diameter growth as brush competed with the conifers for soil moisture. Mortality of plantation trees would occur reducing the number of conifers. As brush dominated plantations would favor the growth of incense-cedar and fir capable of survival in low light (shade tolerant). This would increase the dominance of these shade tolerant species. Conifers would eventually dominate the existing plantation areas but growth would be slow and prone to future high fire mortality (McDonald and Fiddler 1990, McDonald and Fiddler 1995, McDonald and Fiddler 1997, McDonald and Fiddler 2001, McDonald *et al.* 2004, Powers *et al.* 2005).

Within low and very low severity areas brush will invade areas killed by fire and in the understory (Bonnet et al. 2005, Caprio et al. 2006, Crotteau et al. 2013). Over time in these low and very low severity areas understory brush would be reduced in cover and height as surviving trees grow. As overstory tree canopy cover and basal area increases over the analysis period brush growth will slow and brush cover will reduce. When full crown closure occurs in low and very low severity areas brush species will be reduced to scattered individuals or small clumps of brush.

Due to bear clover/ brush competition > 20 percent, lack of seed, poor pine reproduction less than 100 trees per acre over 90 percent of stands, and dominance by shade tolerant incense cedar and white fir where seed is available Alternative 1will not meet the purpose and need to establish conifers and accelerate conifer growth.

Cumulative Effects

Cumulative effects are those activities that additively contribute to cumulative impacts on CWHR, trees per acre, basal area, conifer establishment, and brush cover from alternative 1 and past, present and reasonably foreseeable activities. These past, present and reasonably foreseeable activities include hazard tree removal and BAER activities to stabilize soils.

Cumulative effects on vegetation are examined within the Project's 13,832 acres. Changes to vegetation composition and structure are examined from past, present, and reasonably foreseeable activities. Appendix xx describes the cumulative effects on vegetation from past, present and reasonably foreseeable actions.

Activities with no cumulative effect on vegetation

Road maintenance treatments do not effect sufficient vegetation to create a detectable change in vegetation from existing conditions.

Cattle grazing may affect vegetation locally were cattle are gathered. Cattle do not typically eat brush or trees. Cattle can trample or crush young seedlings. However, design criteria are in place to move cattle from reforested areas that avoids conflicts with young conifer seedlings. Thus, cattle grazing have no detectable effect on brush or tree conifer growth. As a result there is little potential for a cumulative effect.

Travel by recreationists on designated travel results does not change vegetation. Thus 4x4, OHV and snowmobile travel has no potential for a cumulative effect on vegetation.

Past vegetation management projects are older than 10 years. As a result these past treatments are reflected in the existing vegetation described in the existing condition. The existing condition describes how past vegetation treatments and disturbances have shape the existing condition.

Activities with cumulative effect on vegetation

Hazard tree removal is discussed as both a recent past and present action. The ongoing Mile High Roadside Salvage project is discussed in conjunction with proposed treatments to determine cumulative effect. BAER treatments are discussed as a past action.

Indicator 1: Changes in Forest Structure related to Fire Severity .

Under alternative 1, no action, the effects of the French Fire will persist for decades. The combination of drought, insects, high tree density patches, and fire injured trees creates low resilience and more severe fire effects on surviving trees. Due to continuing exceptional drought conditions, high bark beetle populations, and numerous fire injured trees, substantial additional mortality is likely over the next 2 to 5 years. It could conservatively take 150 to 200 years before the French Fire area returns to conditions similar to those present prior to the fire. Existing hazard tree conditions have no cumulative effect on CWHR habitat. Existing hazard sales remove only scattered trees with a high probability of mortality. These results in small pockets of fire killed snag habitat, due to the scattered nature of the removal snag habitat direct effects are also scattered and dispersed. Grazing and BAER treatments result in negligible effects to CWHR habitat dead or alive. Cumulatively less than 2 percent of total Project acres are affected by the Mile High Roadside Salvage project, or BAER activities.

Indicator 2: Number of Trees per Acre and Basal Area Live and Dead

Trees per acre and live tree basal area per acre are reduced across the Project as a result of the French Fire. Live tree numbers across the Project would likely continue to decrease as a result of fire injury, drought, and bark beetles. Dead trees would continue to accumulate as a result of fire injury, insects and drought. The Mile High Roadside Salvage project removes hazard trees along Road 4S81 within the French Fire perimeter. BAER rehabilitation treatments are localized and dispersed across the landscape and have negligible to no measurable effects on forest vegetation.

The No Action leaves high numbers of snags across the landscape; however this high snag density may not increase the longevity that snags are found on the landscape. Ritchie et al. 2013 found that since most retained snag basal area (especially pine) fell within the first 8 years, the contribution to wildlife habitat in retained pine snags was brief relative to the more than 100 years necessary to grow replacement trees of sufficient size to produce habitat in the future. However, large snags greater than 24 inches are retained longer on the landscape than smaller trees.

Indicator 3: Hazard Tree Removal

Hazard tree removal of live or green trees is localized and small compared to the Project size. Most hazard trees in this Project are identified as a result of fire injury. Hazard trees would continue to accumulate as a result of fire injury, insects and drought. These localized changes in live or green tree numbers or canopy cover have no measurable effect on tree canopy cover over the Project area. No hazard trees would be removed under Alternative 1. There are no cumulative effects of forest structure from Burned area Rehabilitation. Hazard trees would remain on approximately 48 miles of road not treated with the Mile High Roadside Salvage project.

Indicator 4: Conifer reforestation, bear clover, and brush

The cumulative effect of no action and the Mile High Roadside Salvage project across the Project area is increased dominance of bear clover and brush species in high and moderate severity burn areas. The No Action alternative would maintain CWHR size and density classes dominated by low conifer tree canopy and tree size or montane chaparral. The No Action Alternative would see an increase in understory brush as a result of scattered pockets of tree mortality.

Table 24. Alternative 1 Effects Summary. The table displays the acres and percent of Project area dominated by conifer/oaks, bear clover/brush and established seedling under Alternative 1.

Vegetation dominance group	High and moderate severity post fire now bear clover/brush dominated	Proposed for conifer establishment effective bear clover/brush control	Existing brush surviving fire	Low and very low severity with green intact tree cover	Total
Acres	9,415	0	413	4,000	13,832
Percent of Project	68%	0%	3%	29%	100%

Effects from the French Fire dominate changes across the Project area.

Snag objectives are met across the landscape. Hazard trees remain along approximately 48 miles of road not treated by the Mile High Roadside Salvage entry.

Bear clover and brush cover and very slow shade tolerant conifer establishment result in large areas dominated by brush. High fuel loads in high and moderate severity areas coupled with slow conifer reestablishment threaten to maintain permanent brush dominance. The reintroduction of fire as a management tool into the fire area will be very difficult to accomplish due to the abundance of live (brush) and dead fuels and small size of conifer regeneration. Low and very low severity areas create areas of reduced fuel and “old forest” structures. Alternative 1 meets the LRMP standard and guideline 14 to retain 10 percent of the total fire un-harvested. However, it could take 125 to 150 years before much of the French Fire area achieves “old forest” (4M) characteristics.

3.6.4. Alternative 2 (Proposed Action)

Direct and Indirect Effects

The first entry salvage treatments are proposed to treat areas predominately characterized as high severity burn areas. Plantation salvage treatments are proposed to treat plantations not included within the first entry stands. Portions of some plantations would retain stand structure where mortality was less severe. Roadside hazard treatment areas not within the initial or secondary entry stands would have hazard trees removed along roads within the fire perimeter. Secondary entry salvage areas would treat areas predominately characterized as moderate to high fire severity stands. This alternative does not propose to treat moderate to low fire severity stands. First entry, plantation and secondary entry areas would treat burned areas characterized as ponderosa pine, Sierra mixed conifer or Montane hardwood-conifer stands. Roadside hazard tree treatments would occur across all CWHR classifications where roadside hazard trees are present.

Indicator 1: Changes in Forest Structure related to Fire Severity

Changes in CWHR result from altering live tree canopy cover or tree size. Since Alternative 2 does not remove live trees there are no direct effects to CWHR size or tree density classes. Pre-fire CWHR size and density within proposed treatment areas was predominately CWHR 4M and 4D.

Indirect effects on CWHR are those that occur as a result of growth, mortality or proposed treatments. Establishment of conifers and release treatments create conditions for future forest growth, structure and resulting CWHR size and canopy density.

Alternative 2 would establish conifers on up to 3,000 acres. Reforestation is the result of both planting and natural regeneration. Treatments that increase the growth and survival of conifers accelerate diameter growth and tree canopy cover. Accelerated dbh growth and canopy cover development would result in achieving pre-fire forest structural conditions more quickly.

A concern was expressed during the scoping period that the French Fire should be allowed to regenerate naturally and not be planted. RAVG mapping indicates that 5,215 acres of stands with a conifer component within the French Fire experienced moderate and high fire severity. Although more than 3,000 acres were considered to be in need to be reforested, approximately 3,000 acres of the most in need high and moderate fire severity patches would be reforested after site preparation treatments (mastication, tractor pile, grapple pile, crush, jack pot burn, chemical and hand), planting, natural regeneration, and release treatments in Alternative 2.

Approximately 2,215 acres of conifer typed high and moderate severity burn areas would not receive treatments. Approximately 4,200 acres of high and moderate severity burn area oak or shrub dominated vegetation types would also not receive treatment to accelerate growth. These untreated areas would develop tree and early seral stage brush cover in the same way as those described for the no action alternative.

The snag removal would also recover economic value that would be used to offset the cost of reforestation activities. Thus the salvage of fire-affected trees creates the conditions for the recovery and persistence of reestablished conifer stands.

Reforestation efforts (site preparation, planting and release) plant new trees and take advantage of natural regeneration resulting in predictable results in conifer survival and growth (Fiske 1981, Tappenier and McDonald 1996). Areas proposed for planting would reduce bear clover, grass and brush competition for the first 5 to 10 years allowing for conifers to be free to grow and become established. These treatments would set stands on a trajectory to conifer dominance and the creation of structures similar to those that existed pre-fire. They would also provide opportunities to restore forest structure consistent with historical conditions (Sensenig et al. 2013). These treatments would accelerate the return of small to large tree size and tree canopy cover within 70 to 80 years.

Reforestation treatments in high and moderate severity areas would result in stands dominated by conifers and sprouting oaks. Pre-fire mixed-conifer and ponderosa pine vegetation types would be maintained. Reforested high and moderate severity areas in nearby past fires – 1939 Source Point fire and 1994 Big Creek fire provide two examples of the effect of post fire reforestation on CWHR tree size and canopy density.

Five years after establishment conifers clearly dominated the 1994 reforested areas in the Big Creek fire. Dbhs ranged from 2 to 5 inches and canopy cover from 10 to 20 percent (CWHR tree size and canopy density “2S”). After 10 to 20 years conifers were established and trees averaged 4 to 8 inches dbh and canopy cover was 20 to 30 percent. These 10 to 20 year old stands were CWHR tree class “2” or “3” and canopy cover “S” or “P” (based upon plot data and recent observations). Areas planted as strategic fire areas using the extra-wide planting strategy would appear slightly more open (CWHR tree canopy density “S”), but the lower tree density would result in larger trees (CWHR tree size class “3”). With lower fuel loads resulting from treatment, fire could be used in the future to maintain the open stand conditions. After 30 years trees would average 9 to 11 inches dbh and canopy density would be approaching a CWHR “M”.

The High Sierra Ranger District's Source Point fire plantings provide another example of managed forest growth. The Source Point conifer establishment occurred in 1962 to 1972. Planted trees dominated stands after five years. These planted stands were approximately 10 to 15 inches dbh and 35 to 60 percent canopy cover in 1993 based upon stand exams. CWHR size and density classes in these 20 to 30 year old stands included 3P, 3M, and 4M. At the time of the Aspen fire (2013) these 40 to 50 year old stands had attained structures consistent with spotted owl habitat or CWHR 4M and 4D.

Reforestation treatments accelerate the return of conifer dominance and the return of moderate and dense tree cover associated with species dependent on "old forest" habitat. Experience with reforestation on similar sites indicates that dominant trees greater than 11 inches dbh occur within 30 to 40 years after establishment with low bear clover/brush competition (below 20 percent). Experience on the SNF and research indicate that reforestation treatments accelerate tree growth and the resulting habitat structures associated with large trees and dense tree canopy cover.

Within moderate severity areas, fire affects and insect attacks will continue to reduce canopy cover for the first 2 to 5 years. This continued mortality will not affect the CWHR type, size or density, since so few trees survived the fire.

Within low and very low severity areas tree canopy cover would continue to drop for 2 to 5 years as fire effects weaken trees and bark beetle mortality continues to kill trees. CWHR canopy density classes will decrease within portions of stands as mortality continues to occur. After 5 to 10 years canopy cover would begin to increase as surviving trees reoccupy space of fire-affected trees. In conifer dominated areas CWHR size and density classes would shift to larger trees and denser canopy. Post fire size and canopy classes 4M, 4D, 5M, 5D combined would increase from a post fire approximately 45 percent tree canopy cover to approximately 55 percent tree canopy cover after 30 years. Post fire size and canopy classes 4P, 4S, 5P, 5S combined would increase from a post fire approximately 30 percent tree canopy cover to approximately 40 percent after 30 years. Portions of the low and very low severity burn areas would provide "old forest" habitat for species like spotted owl and pacific fisher.

In conclusion, Alternative 2 treatments reduce snag habitat and early seral stage brush CWHR habitat, increase the dominance of conifers over time and increase the growth of conifer dominated CWHR types. Reductions in snags and early seral stage brush create conditions that result in meeting the purpose and need to accelerate large trees that in turn accelerate the development of "old forest" habitat while retaining substantial acreages of early seral stage brush as well as the retention of large numbers of snags.

The greatest treatment impacts to CWHR are from the establishment of conifers. Conifer reforestation would accelerate the growth and dominance of conifers on 3,000 acres. This is 38 percent of the 7,967 acres typed with a conifer component prior to the fire and 58 percent of conifer typed stands within the high/moderate severity burn areas. The CWHR type within these 3,000 acres would once again become dominated by conifers rather than brush over time. Size and canopy density are dominated by seedlings and saplings in the first 15 years (size 1 and 2). Secondary succession and resulting brush species would dominate 2,214 acres of the pre-fire conifer CWHR types within the high and moderate fire severity burn areas. The greatest landscape impacts to CWHR tree size and density classes occur as a result of the French Fire and secondary succession, not from proposed treatments.

Indicator 2: Number of Trees per Acre and Basal Area Live and Dead

Alternative 2 proposes to remove fire-affected trees and insect killed trees. Incidental removal/damage of live trees is likely to occur in areas proposed for secondary salvage; high and moderate severity areas contain few live greater than 10 inches dbh and are unlikely to have any damage. Damage and landing creation typically result in 1 to 20 live trees greater than 10 inches removed per landing and connecting skid trails. Since salvage of fire-affected trees takes place in high and moderate severity and few live trees exist in these treatment areas; few live trees are expected to be removed to create landings or skid trails.

Following salvage removal and site preparation treatments, an average of 16.4 snags per acre greater than 15 inches dbh (Table33: Landscape Scale Assessment of Large Snags, Wildlife Section) would remain within the fire area. Areas of dead trees within secondary salvage areas are expected to increase as drought and bark beetle mortality take their toll. Additional mortality within the secondary salvage areas would be removed during the secondary treatment. Additional mortality occurring following secondary treatments would remain as additional snag habitat.

Snags remaining after harvest would include snags remaining in salvage harvest areas, secondary salvage areas, and snag retention areas (patches and untreated areas) as well as untreated areas within the Project area. On the average approximately 4 snags per acre would remain within the initial treatment and secondary salvage areas immediately after treatment. Very few snags would remain in hazard tree areas within 150 feet of roadsides. On the average an estimated 20 snags per acre would remain in the outer 150 foot roadside strip. An estimated average of 25 snags per acre would be present within the untreated areas of the fire. (Refer to Otto 2015 Wildlife BA).

Trees per Acre

High and moderate severity fire greatly reduced the number of live trees. Treatments would reduce the number of snags. Large tree death (greater than 24 inches) and removal is of specific importance because of the time necessary to replace large tree structures. Recovery of forest structures, especially the number of large trees, requires time to develop and a period free of stand replacing events. Alternative 2 retains snags to meet the SNF LRMP S&G The French Fire killed large trees in high and moderate fire severity areas that would provide for future large snags. Reforestation provides future snag recruitment opportunities. Snag fall rate is unaffected by snag density (Ritchie et al 2013), that is leaving more snags does not create more future snags. Snags in treated and untreated high and moderate fire severity areas lose snags at about the same rate and leave less than 1 large snag per acre after 20 to 30 years. However, large snags stand longer than small snags (Ritchie et al. 2013). Alternative 2 retains some of the largest snags in treated areas. Thus, Alternative 2 provides for the presence of snags in salvage logged areas. Across the entire Project more than 16 snags per acre are retained on the average. The number of trees and snags change as a result seedling establishment, tree growth, snag decay and snag fall down rates.

Conifer reestablishment in all areas not proposed for treatment under this alternative would be the same as described for those areas in Alternative 1 (natural regeneration).

The growth and survival response of planted conifer seedlings following the fire within high/moderate areas is predictable. In high and moderate areas planting will generally occur between the spring of 2016 and 2022. In these reforested areas conifer reforestation efforts will result in planting of about 320 to 360 seedlings per acre (including existing stump sprouted oaks) (the lower number being planted on poorer growing sites). Stocking would be lighter on south facing slopes and heavier on north slopes. Seedlings (ponderosa pine, Jeffrey pine, blister rust resistant sugar pine, incense cedar, and white fir would be planted.

In areas of plantations with stocking exceeding desired levels, natural and planted seedlings would generally be thinned during release treatments; typically this release and thinning would occur four or five years following planting leaving about 150 to 225 seedlings per acre depending on site quality and aspect.

The Sierra LRMP as amended by SNFPA standard is 4 snags per acre greater than 15 inches dbh for ponderosa pine and mixed-conifer forest types. Frequent fire regime forests, such as those found in the French Fire; retain approximately 2 to 4 snags per acre > 15 inches dbh (Safford 2013). Ponderosa pine and mixed-conifer forest types would contain approximately 4 snags per acre post-harvest in the initial and secondary treatment areas; this is reduced through decay and breakage to approximately 1 snag per acre in salvage areas and 3 snags per acre in secondary salvage areas after 30 years assuming no other future unplanned disturbances (fire or insect mortality). Snags in the secondary salvage include green live trees that die over the 30 year period. Snags fall at approximately the same rate with treated stands and snag retention areas (Ritchie et al. 2013), most snags within treated areas are expected to be down within the first ten years. Russell (2006) shows that ponderosa pine has a

snag life expectancy of seven to ten years. White fir snags persists the longest Ritchie et al. 2013. Ritchie et al. 2013 found that most snags fell within 8 years after being killed by fire and that 40 percent of trees larger than 11 inches dbh were standing by year eight. These studies along with Chambers and Mast study (2005) suggest a burned snag life expectancy of three to eight years. The numbers of snags and subsequent log accumulation are consistent with historical Sierra Nevada forest and the LRMP guidelines.

Basal Area

Live tree basal area would be slow to accumulate in high and moderate areas. The fire killed more than 94 percent of the basal area in high severity areas on average and more than 83 percent in moderate to high areas on average. Plot data indicate that even in the moderate to low burn severity areas basal area mortality was 66 percent. As a result additional basal area growth is dependent on the reestablishment of new trees. Basal area in conifer dominated high/moderate areas post fire is 8 to 22 square feet of basal area found in scattered clumps of survivors. Reforestation treatments result in a predictable increase in conifer dominance and basal area per acre. Basal area increases as planted conifers grow and competing vegetation is maintained below 20 percent for the first five years after establishment. Basal area increases slowly the first decade as trees establish root systems and foliage; increases in diameter result after roots, foliage and height occurs. The Lookout point plantations within the 2013 Aspen project on the High Sierra Ranger District and computer models clearly show how treatments effect basal area growth. Basal area averages 5 to 15 square feet per acre in the 10 years after conifer establishment. After 20 years established tree basal area ranges from 40 to 70 square feet per acre. At 30 to 40 years basal area ranges from 80 to 160 square feet per acre. The range in basal area reflects established trees per acre depending on site quality. Better sites result in faster tree growth and support more basal area per acre.

Snag basal area decreases as a result of decay and breakage. Several unpredictable factors control the rate of decay and breakage; wind, snow, rot and insects. Within salvaged areas snag basal area per acre is essentially gone after 30 years. Within secondary salvage areas snag basal area is replenished as a result of density induced mortality. Future snag creation assumes density induced mortality and that no unplanned events such as bark beetle attack or fire result in additional large pulses of tree mortality.

Treatments that reduce snag and tree numbers also reduce snag and tree basal area. Areas of higher snag basal area would result in more surface fuels in the future if left untreated (Ritchie et al. 2013). Approximately 80 percent of biomass that will become surface fuels falls within the first 8 years post fire. Thus untreated areas and snag retention areas would have the highest basal area (CWHR 3d, 3m, 4D, 4M, AND 5D) and would also have the highest subsequent fuel load. Salvage treated areas would have lower fuel loads and provide early application of prescribed fire (Refer to Otto 2015 Wildlife BA for additional snag details).

Incidental removal of live trees resulting from landing and skid trail development has little to no effect on basal area at the stand or within any forest type.

Changes in live tree basal area in the low and very low severity areas are the same as those described in the No Action alternative 1.

There are 5,214 acres of high and moderate fire severity conifer typed stands within the French Fire perimeter. Montane hardwoods comprise another 2,753 acres of high and moderate severity burn areas. Prior to the French Fire, there were 12,092 acres of CWHR typed forested lands within the fire perimeter. Of those, 7,967 acres were typed as containing a conifer component. 5,214 acres of the conifer stands suffered moderate and high burn severity. Alternative 2 would treat about 1,984 acres with first entry treatments, up to 910 acres within secondary entry treatments (due to draws, poor site, archaeological sites, etc., approximately 15 to 20 percent of the secondary treatment area gross acres would likely not be treated once actual treatment areas are delineated on the ground.), 477 acres of plantations, 2,353 gross acres of roadside hazard treatments, 112 acres of powerline cleanup, 96 acres of DFPZs and 32 acres of medusahead treatments. These treatments total approximately 58 percent of conifer typed stands.

Over all vegetation types (13,832 acres), Alternative 2 would treat up to 5,965 gross acres (first entry, secondary entry, plantations, roadside hazards, powerline right-of-way, DFPZs and medusahead infestations); 7,867 acres would not be treated.

Approximately 4 snags per acre would remain following treatments within the initial and secondary entry areas, 0 snags per acre would remain within the DFPZs and SCE powerline corridor, 0 snags per acre would remain within the first 150 feet of the roadside hazard treatment areas and 20 snags per acre would remain in the outer 150 feet of the roadside hazard treatment areas. On the average 16 snags per acre would remain within the perimeter of the French Fire following completion of treatments. Approximately 24.9 snags per acre would remain in areas outside proposed treatment areas (Otto 2015 Wildlife B.A.).

Reforestation efforts would establish approximately 200 trees per acre over 3,000 acres for a total increase in tree numbers of approximately 600,000 trees, including sprouting oaks, 10 years after the French Fire.

In summary, while approximately 43 percent of the Project area would see salvage of fire-affected trees, secondary salvage, or hazard tree removal, the cumulative effect of alternative 2 retains more than 16 snags greater than 15 inches per acre well distributed across the Project. Alternative 2 meets the purpose and need for snag habitat. Alternative 2 accelerates conifer growth on approximately 22 percent of total Project acres typed with a conifer component, and 58 percent of high and moderate conifer typed areas. Alternative 2 meets the purpose and need to accelerate growth, but fire effects and unplanned secondary succession dominate the Project area.

Basal area provides a measure of conifer dominance and snag habitat. Treatments remove few green trees and thus remove a small fraction of the project live basal area. Alternative 2 would salvage harvest on approximately 1984 acres during the first entry, salvage harvest on approximately 477 acres of plantations during the first treatment, remove roadside hazard trees on approximately 2353 (gross) acres during the first treatment and salvage harvest on up to approximately 910 acres during secondary entry treatments. Following all treatments, an average of approximately over 16 snags per acre would remain across the fire area.

Indicator 3: Hazard Tree Removal

Alternative 2 would implement treatments that remove hazards as a part of the SNF hazard tree abatement program. Merchantable trees meeting the hazard tree marking guidelines would be removed from roads or developed areas. This would include trees killed immediately by the fire or that succumb to the effects of fire and insects 3 to 5 years following the fire as well as trees with structural instability that may still have green foliage. A review of the area by Forest Health Protection staff in the fall of 2014 concluded that due to continued extreme drought conditions and the potential for insect attack mortality could continue for up to 5 years. The District would also use the “Marking Guidelines for Fire-injured trees in California” (Smith and Cluck 2011). Guidelines developed by the Pacific Southwest Region Forest Health Protection Staff also take into account pre and post-bud flushing in conifers in determining potential mortality. Flushing will be taken into consideration in implementing these mortality guidelines. If flushing is not taken into account, it may incorrectly estimate probability of mortality (Hanson and North 2009).

The analysis area for hazard trees is 300 feet either side of roads. Approximately 3,712 acres occur within 300 feet of roads identified for hazard removal. Of these 3,712 acres, 1,359 acres occur within first entry, secondary entry and plantation salvage areas leaving 2,353 acres within 300 feet of roads proposed for hazard removal. However, Tree heights and experience indicate that 90 percent of hazard trees fall within the 150 feet distance of the road. The remaining 10 percent of hazard trees are located beyond 150 feet and present hazards due to tree heights that exceed 150 feet or steep slopes with hazard trees that overhang roads. Hazard areas that overlap with salvage of fire-affected trees would be harvested concurrently with fire salvage. Hazards in low severity areas tend to be scattered rather than clumped.

Hazard trees may be present within all vegetation types within the hazard roadside analysis area. Additional hazards may be created by fire effects and secondary effects of drought and insect mortality. The actual tree removal in any stand is the result of fire effects, pre-fire vegetation density, and vegetation type. The effects of roadside hazard removal are limited to the areas adjacent and within one and one half tree heights of the road or further away based upon slope steepness and lean of trees. Trees less than 10 inches dbh will be felled by contractors or forest employees.

The removal of fire killed trees while trees contain economic value shifts the economic burden from appropriated dollars to the use of timber value. Thus Alternative 2 captures timber value and uses the timber value to remove hazards in order to create safe roadways. Since most timber value is lost in the first 1 to 2 years following a fire, the timely removal of roadside hazards maximizes public and forest worker safety and economic value.

Alternative 2 would remove hazards from all roads while still retaining an average of 16 snags greater than 15 inches in the Project area. Since the Mile High Roadside Salvage project removes trees using a high probability of mortality (80pm), it will tend to leave trees that might otherwise die. The 80 pm is a conservative mark that places a high value on leaving trees that might survive. Thus Alternative 2 hazard tree removal would revisit all roads again.

By removing fire-affected trees that would decay and become unstable along roadsides, Alternative 2 meets the purpose and need to maintain safe travel ways.

Indicator 4: Conifer reforestation, bear clover, and brush

The direct effects of the Alternative 2 treatments (salvage, site preparation, planting and release) would be to create a predictable environment for seedling establishment on 3,000 acres of high/moderate severity patches and plantations damaged or destroyed by fire. Conifer reforestation treatments apply methods known to result in conifer and oak growth and survival consistent with objectives to insure a timber supply and large tree habitat. Reforestation methods include the collection of seed from species and forest zones suited for planting sites; proper planting techniques to insure survival; reducing competing vegetation to provide for growth and survival; reducing fuel loads to reduce the potential for damage from fire; and controlling tree spacing to reduce inter-tree competition for site resources.

Mechanical site preparation treatments and pile burning are proposed on approximately 1,850 acres. Mechanical treatments reduce the volume of dead material, reduce fuel loads and disrupt below ground brush roots. Mastication treatments shred dead material and rearrange and distribute dead material providing additional soil cover. Grapple and tractor piling treatments both create areas accessible for planting and reduce the fuel load associated with post salvage material and fire mortality. However, these same mechanical treatments along with harvest activities can reduce regeneration to less 100 seedlings per acre in the 2 years after fire (Donato et al. 2006). The French Fire created very large high severity patches. Due to a lack of available seed trees, very little natural regeneration will occur. Harvest and mechanical site preparation treatments would have little impact on natural regeneration.

Successful establishment of pine plantations hinges on early control of competing vegetation before competing vegetation can capture scarce resources (McDonald and Fiddler 1989). Early dominance of conifers reduces the need for additional release or brush control measures. Once conifer crowns and root systems occupy site resources, brush cover is reduced. Conifers would occupy the site within 10 to 15 years following planting.

In high and moderate severity areas, seedling planting would primarily take place between the spring of 2016 and 2022. In these reforested areas conifer reforestation efforts would result in planting of about 320 to 360 seedlings per acre (including existing stump sprouted oaks) (the lower number being planted on poorer growing sites). Stocking would be lighter on south facing slopes and heavier on north slopes.

Seedlings (ponderosa pine, Jeffrey pine, rust resistant sugar pine, incense cedar and some white fir) would be planted. In areas of plantations with stocking exceeding desired levels, natural and planted seedlings would be thinned during release treatments; typically this release and thinning would occur 4 or 5 years following planting leaving about 150 to 225 seedlings per acre.

The objective would be to retain 190 to 200 trees per acre at the end of five years. (Typically in the 1960s and 1970s plantation stocking at the end of 5 years would have been around 320 to 350 trees per acre).

Due to the large lack of seed trees across the majority of the area proposed for the initial entry, a very limited amount of natural regeneration is expected. However, where present, naturally regenerated seedlings will be included as part of the new stand. Since only 3,000 acres are proposed for replanting within the French Fire, natural regeneration would be the mechanism for regenerating the remaining areas of the fire lacking in young conifers.

Alternative 2 would plant and release conifers. In the open full sun conditions the reforestation of high/moderate severity patches favors the survival and growth of pine species. Pine was the dominant species prior to the advent of organized fire suppression as well as pre-fire. Several studies indicate the need to control bear clover, brush and grass to insure the survival and growth of pine (McDonald and Fiddler 2010)(McDonald, et al., 2004) and that conifer survival and growth meet typical forest standards with brush cover below a threshold of 20 percent, active management is often necessary to create conditions for shade intolerant (sun loving) pine. In areas with many burned small trees or unmerchantable material, standing dead material is felled or pushed to make room for planting and reduce fuel loads. The direct effect of Alternative 2 salvage removal, site preparation, planting, control of bear clover and brush, and tree spacing is to create an environment suitable for establishment and growth of shade intolerant species such as pine. These actions would also accelerate conifer growth.

Alternative 2 would primarily treat bear clover during site preparation following slash treatments before it has the opportunity to compete with planted seedlings. In some instances, where planting is accomplished prior to bear clover becoming reestablished or the initial site preparation treatment was unsuccessful, bear clover would be treated during a release treatment. Depending on slash concentrations, herbicide treatments can be expected to occur as soon as 2017, this would allow for planting to begin in 2018.

Competing bear clover would be treated by a directed backpack spray of glyphosate + surfactant. Herbicide treatment of bear clover is most effective when bear clover is in the flowering stage (generally April to mid May). The direct effect of this treatment is to kill both the above ground stem and the below ground rhizomes. Bear clover is seldom eliminated from an area treated with glyphosate. Grasses often invade areas with reduced cover of bear clover and other brush species. Grasses are effective competitors for site resources. Competition from grasses can be effectively treated using follow-up hand release methods.

Green leaf manzanita, deer brush, bitter cherry, lupine, and whitethorn are sprouting species and also germinate from seed stored in the soil. Direct effects on ceanothus species, lupine, bitter cherry, and green leaf manzanita are reductions of above ground cover through mastication, mechanical piling, and hand cutting (chainsaws and manual release). Below ground root systems will be disrupted or killed through tractor piling (brush rake) and chemical application. Each treatment has a differing effect on the species capable of sprouting. Treatments that remove only the above ground stems of sprouting species are ineffective in control. However, the above ground removal reduces the size of plants and reduces leaf cuticle thickness. Both these results make subsequent chemical treatments more effective. Tractor and grapple piling serve to disrupt below ground roots, reduces the mass of roots, but stimulates sprouting. Due to the severity of the fire in the areas proposed for reforestation, most brush present during site preparation would be too small for tractor piling. Some larger plants would be piled during site preparation treatments.

Glyphosate chemical spraying of ceanothus species is most effective when sprayed on small and tender plants. Resprouting brush as well as brush seedlings that germinated following the fire would be treated with glyphosate at the same time as the bear clover treatment.

Hand cutting would be used to control ceanothus cordulatus, white leaf manzanita, and Mariposa manzanita seedlings. White leaf manzanita seed stored in the soil is stimulated to grow by fire. Fire can stimulate many thousands of dormant seed to grow. Early hand release of white leaf manzanita is an effective control. Manual release of ceanothus cordulatus is ineffective on large plants. Manual treatments are not able to effectively cut plants, and large roots simply re-sprout. Manual treatments on ceanothus intergermis are ineffective and are not planned. Where needed for fuel reduction or to create planting areas, Alternative 2 would treat existing large plants (> 2 feet tall) or were large fire killed brush skeletons exist through hand cutting, crushing or shredding (mastication).

Inter-planting and release is proposed for plantations heavily damaged by fire, but still have surviving saplings or poles. Inter-planting results in conifer dominance by adding conifer seedlings to areas killed by fire.

Non-target plant species are likely to be killed by proposed treatments. This is true for both mechanical and chemical treatments. Both the mechanical and chemical treatments are proposed for stands that will contain a mosaic of both understory vegetation and logging residue. Mechanical treatments while directed at larger woody plants and removal of logging residue will tend to treat all brush species found in areas available for treatment (outside of streamside management zones, and control sites). Chemical treatments may also kill non-target species in treated areas. This results from the intermixing of target and non-target species. However, past experience and research indicates that non-target species are not eliminated from treated stands (McDonald and Fiddler 1995).

Cumulative Effects

Cumulative effects are those activities that additively contribute to cumulative impacts on CWHR, trees per acre, basal area, conifer establishment, and brush cover from Alternative 2 and past, present and reasonably foreseeable activities. These past, present and reasonably foreseeable activities include hazard tree removal and BAER activities to stabilize soils.

Cumulative effects on vegetation are examined within the 13,832 Project acres. Changes to vegetation composition and structure are examined from past, present, and reasonably foreseeable activities.

Activities with no cumulative effect on vegetation include:

- Road maintenance treatments do not effect sufficient vegetation to create a detectable change in vegetation from existing conditions.
- Cattle grazing may affect vegetation locally were cattle are gathered. Cattle do not typically eat brush or trees. Cattle can trample or crush young seedlings. However, design criteria are in place to move cattle from reforested areas that avoids conflicts with young conifer seedlings. Thus, cattle grazing have no detectable effect on brush or tree conifer growth. As a result there is no potential for cumulative effect.
- Travel by recreationists on designated travel routes does not change vegetation. Thus 4x4, OHV and snowmobile travel has no potential for a cumulative effect on vegetation.
- Past vegetation management projects are older than 10 years. As a result, these past treatments are reflected in the existing condition. The existing condition describes how past vegetation treatments and disturbances have shaped the existing condition.

Activities with cumulative effect on vegetation include:

- Hazard tree removal is discussed as both a recent past and present action. Recent hazard tree removal projects are discussed in conjunction with proposed treatments to determine cumulative effect. Since existing hazard tree decisions remove trees using a high probability of mortality (80pm), these existing hazard projects will tend to leave trees that might otherwise die. The 80 pm is a conservative mark that

places a high value on leaving trees that might survive. Existing hazard decisions remove only the most obvious mortality. Alternative 2 hazard tree removal treatments will revisit all roads following the initial treatment, as needed, to insure hazard trees appearing following the initial treatment are treated.

Indicator 1: Changes in Forest Structure related to Fire Severity

Cumulative effect of Alternative 2 treatments, existing hazard tree decisions, and BAER treatments combined maintain green forest structure except for incidental removal near log landings and scattered green hazard trees within the treated stands.

Hazard tree removal would remove some green unstable trees. These trees are scattered and widely separated across the fire area. Changes from green hazard tree removal have no effect on CWHR density or class and do not result in a cumulative effect on CWHR. Therefore the cumulative effects for this indicator are the same as the effects of the Project.

Indicator 2: Number of Trees per Acre and Basal Area Live and Dead

The direct and indirect effects of alternative 2 include the effects of the Mile High Salvage project. The cumulative effects for vegetation are examined at the project scale therefore the cumulative effects for this indicator are the same as for the Project.

Indicator 3: Hazard Tree Removal

Alternative 2 would treat hazards along all roads. More than one hazard tree removal entry may be necessary in order to treat roadside hazard trees as additional hazard trees appear due to the drought, insects and the lingering effects of fire. A total of 2,353 acres outside of first and secondary entry stands and plantations would be treated for removal of hazard trees. Most, approximately 90 per cent, would be removed within the first 150 feet of roadways. An estimated 20 snags per acre would remain standing in the outer 150 feet following treatment. Hazard trees within initial and secondary treatment areas and plantations would be removed during implementation. Trees hazardous to the public within roadside hazard treatment areas would be removed under this alternative while retaining estimated average 16.4 snags per acre across the Project area following implementation of alternative 2 and the Mile High Salvage project.

Indicator 4: Conifer reforestation, bear clover, and brush

Under alternative 2, planting would occur within the first and secondary entry stands as well as high and moderate severity roadside hazard tree removal areas vegetated with conifers prior to the French Fire. Snag retention areas would be left untreated and would be dominated by bear clover/brush in the short term. Oak and shrub vegetation types with high and moderate severity would also be dominated by bear clover/brush. Table 16 displays the dominance of conifers/oaks, and bear clover/brush across the Project area with Alternative 2. Snag retention, oak and shrub vegetation types would be dominated by bear clover/brush for 20 to 50 years or longer. Approximately 9,415 acres burned at high and moderate severity killing most vegetation and creating bear clover/brush dominated conditions. Of the 13,832 acres within the French Fire, approximately 6,415 acres across the Project area with high and moderate fire severity would be dominated by early seral bear clover/brush species, 3,000 acres are proposed for conifer reforestation, and 4,420 acres would have a mosaic of green tree cover and openings on low and very low (RAVG 0-25% basal area mortality—39% mortality—plot data) severity acres. The reforested acres would be dominated by conifers within 5 to 10 years after plantation establishment. Near the fringes of planted areas planted trees will play a future roll in seedling reestablishment beyond the planting boundary. As these planted trees reach cone bearing age, planted trees will be able to provide a seed source for some of the areas remaining with few established conifers. The cumulative effect of Alternative 2 treatments, hazard tree removal with current decisions, and brush growth is a landscape with 46 percent of the acres dominated by early seral bear clover/brush species, 22 percent dominated by young conifer plantations created by Alternative 2, and 32 percent with a mosaic of green tree structure and openings.

Table 25. Table displays the dominance of conifer/oaks and bear clover/brush across the Project areas with Alternative 2.

Vegetation dominance group	High and moderate severity post fire now bear clover/brush dominated	Proposed for conifer establishment effective bear clover/brush control	Existing brush surviving fire	Low and very low severity with green intact tree cover	Total
Acres	6,419	3,000	413	4,000	13,832
Percent of Project	46%	22%	3%	29%	100%

The Mile High Roadside Salvage project along Road 4S81 and BAER work combined with proposed treatments in Alternative 2 result in a large areas dominated by early seral bear clover/brush and snags with about 22 percent of the Project area treated to recreate forested conditions to capture greenhouse gases and accelerate "old forest" desired structures (Table 26). Hazard trees are effectively removed and provide safe roadways. Snag objectives are met across the Project area. Tree numbers increase rapidly with treatments on 22 percent of the landscape while retaining approximately 46 percent of the Project area dominated by early seral bear clover/brush. Fuel loads and brush continue to pose a high fuels hazard across most of the Project area. The effects of the French Fire have the greatest impacts on vegetation and trends in conifer dominance over the Project area even with treatments proposed in Alternative 2.

Alternative 2 Effects Summary

In summary, alternative 2 retains approximately 37 percent of the high and moderate severity acres untreated and retains more than 57 percent of the project area affected by fire unharvested. As a result alternative 2 meets SNF LRMP S&G 14 to generally not conduct salvage harvest in 10 percent of the total area. Alternative 2 leaves approximately 57 percent of the project area untreated, which is much more than the 10 percent desired to be left untreated under S&G 14.

As the effects of fire injury, drought and insects take a toll and increase the severity of effects; Alternative 2 would treat secondary entry stands as well as remove additional hazard trees along forest roads. The secondary entry treatment would remove snags created from the delayed effects of fire as well as previously killed trees within the treatment areas. Secondary treatment areas are delineated on the maps. Except for additional roadside hazard trees, secondary treatments would not occur outside of the delineated secondary entry stands. The combination of exceptional drought, effects of the French Fire, and increased bark beetle populations would result in additional snags appearing throughout the untreated areas over the next few years. Some non-treatment forest areas would transition from injured and low severity to dead and moderate to high severity. As a result alternative 2 meets the LRMP standard and guideline 13 that salvage should "avoid areas that are still largely intact".

Salvage treatment and retention areas in alternative 2 incorporated many considerations of Lindenmayer and Noss's "components of an ecologically defensible salvage policy" : Large legacy tree structures remain across the project areas (snag retention, snag groups and retained individual snags), snags are grouped with surviving trees, habitat for woodpeckers is retained, large patches of brush dominate areas dependent on secondary succession for conifer reestablishment, unharvested areas of each vegetation type and elevation remain undisturbed, and slopes greater than 35 percent remain unharvested (2006). Consequently, the design features of Alternative 2 retain many of the biological legacies associated with the post-fire landscape (Franklin and Agee 2003) while balancing with the purposes and needs of the Project.

Alternative 2 meets SNF LRMP S&G 12 to promote shade intolerant pines (sugar and ponderosa) and hardwoods. It also promotes the establishment of blister rust resistant sugar pine. Alternative 2 meets the purpose and need to establish conifers and accelerate conifer growth while retaining snags and untreated areas.

3.6.5. Alternative 3 (No Herbicide)

Direct and Indirect Effects

Indicator 1: Changes in Forest Structure related to Fire Severity

Alternative 3 proposes to harvest and remove roadside hazard trees on the same acres as alternative 2; as a result, alternative 3 has the same direct effects on changes in forest structure related to fire severity as alternative 2.

Indicators 2 and 3: Number of Trees per Acre and Basal Area Live and Dead; Hazard Tree Removal

Alternative 3 proposes to treat the same snag habitat acres, hazard trees, and plant the same acres as Alternative 2; as a result Alternative 3 has the same direct effects on Snag and Trees per acre, hazard trees and basal area as Alternative 2.

Indicator 4: Conifer reforestation, bear clover, and brush

The direct effects from site preparation except for herbicide treatment would be the same for alternative 3 as alternative 2. Initial site preparation using spot tractor piling of slash concentrations by either dozer or grapple piling, jack pot burning of slash concentrations, mastication, crushing of slash with a dozer, etc. would be the same as alternative 2. Mechanical treatments can have the direct effect of reducing the size of above ground stems. However, the below ground root systems of sprouting species (bear clover, green leaf manzanita and ceanothus sp.) are left intact. Any bear clover disturbed during mechanical site preparation treatments would rapidly resprout.

The effect of mechanical fuels and site preparation treatments on brush size, cover, and non-target species is the same as in alternative 2.

Figure 20. Photo displays the effects of hand release in areas dominated by white leaf manzanita (above black line) and areas the effects of hand release in areas dominated by ceanothus spp.

Under Alternative 3, the same 3,000 acres would be planted as in Alternative 2. Planting would be followed immediately with hand release. Bear clover and brush would be hand grubbed (chopped/cut) for a 5 foot radius around all planted trees. Studies have shown that survival rates of planted seedlings in bear clover are 20 percent or less by the first fall (McDonald, et at. 2004). A second planting would be implemented the following spring with a third planting planned for the next spring. After the initial planting and two replanting treatments, overall survival would be around 50 to 100 trees per acre including sprouting oaks. (Tappeiner and Radosevich noted only 13 percent survival at year three in their 1982 study). A second hand release would need to be completed around year 3 with a third hand release taking place around year 6. Bear clover and brush species would occupy up to 85 percent of the area. (Hand releases would only treat around 15 percent). (This amount of competition far exceeds the 20 percent competition threshold.)

For those seedlings that do survive, bear clover, brush and scattered dense conifer clumps delay and slow conifer growth by more than two times (McDonald and Fiddler 2010). Tappeiner and Radosevich (1982) projected a 75 percent reduction in wood production by age 50 with uncontrolled bear clover competition. Due to the extensive bear clover rhizome root systems bear clover would continue to be a noteworthy competitor. The hand release treatments would be mainly for survival. They would not greatly improve growth. The effect of bear clover, brush and patchy dense conifer clumps found in high and moderate severity areas could

conservatively result in it taking 125 to 150 years to return these areas to pre-fire “old forest” conditions “4M” structure depending on site conditions.

Competition from bear clover and brush will result in surviving seedlings remaining susceptible to loss due to insects (Pine Reproduction Weevil, Ipps, etc) and/or drought (McDonald and Fiddler, 1989). McGinnis, et al. (2010) noted that due to the small height and diameter of planted seedlings they would be prone to loss in a wildfire for at least the first twenty years following planting. The potential for conifer loss due to wildfire will be substantially longer in stands with heavy bear clover competition. The small diameters and heights of trees that become established in this extensive bear clover and brush competition will leave these stands prone to loss due to wildfire until they obtain larger diameters many decades in the future.

The indirect result of ineffective control of competing vegetation is that conifer survival is lower and growth is slowed. The lack of initial resources stresses the conifer seedling by causing decreased root expansion, less resource collection, poor growth, and, in many instances, death. Even if the seedling survives, losses in growth are seldom made up (McDonald 2010). In a study of the longer term effects of varying brush competition from 1966 through 1992, ponderosa pine without competition was 25.0 feet, tall; with light competition, 17.5 feet tall; with medium competition, 12.5 feet tall; and with heavy competition, 7.0 feet tall. Bear clover, brush competition in Alternative 3 hand and mechanical treatment areas is expected to be heavy.

A conservative estimate of growth loss would be a tripling of the time necessary to achieve “old forest”. Due to the poor survival rates for seedlings planted in bear clover, even after 3 plantings, very few of the planted acres would meet the minimum SNF LRMP (1992) Standard and Guide 101 reforestation stocking standards. Growth of surviving conifers would be slow and bear clover and brush would dominate for more than 50 years. Thus conifers would not achieve “old forest” conditions for 125 to 150 years depending on site conditions and the amount of bear clover/brush dominated acres. Due to heavy competition with bear clover, surviving trees are projected to reach 15 to 17 feet in height and only 4 to 5 inches dbh by age 50. CWHR densities at 50 years would be a “S” or possibly “P”. By age 70, heights are projected to reach 20 to 30 feet with diameters of 6 to 8 inches dbh.

Due to the poor survival of seedlings in bear clover (less than 20 percent at the end of the first year) and heavy competition, at least 3 plantings will be needed to obtain close to a minimal level of stocking. At least 3 hand releases will be needed to retain this minimal stocking level. Cost estimates for site preparation and 3 planting treatments along with 3 hand release treatments are double those needed to implement Alternative 2. As noted previously, projected growth is about 25 percent of that obtainable under Alternative 2. Alternative 3 would cost twice as much to reforest as Alternative 2, only obtain minimal stocking and only obtain about 25 percent of the growth obtainable with Alternative 2.

Alternative 3 proposes to treat the same snag habitat acres as Alternative 3; as a result Alternative 3 has the same direct effects on CWHR and snag habitat as alternative 2.

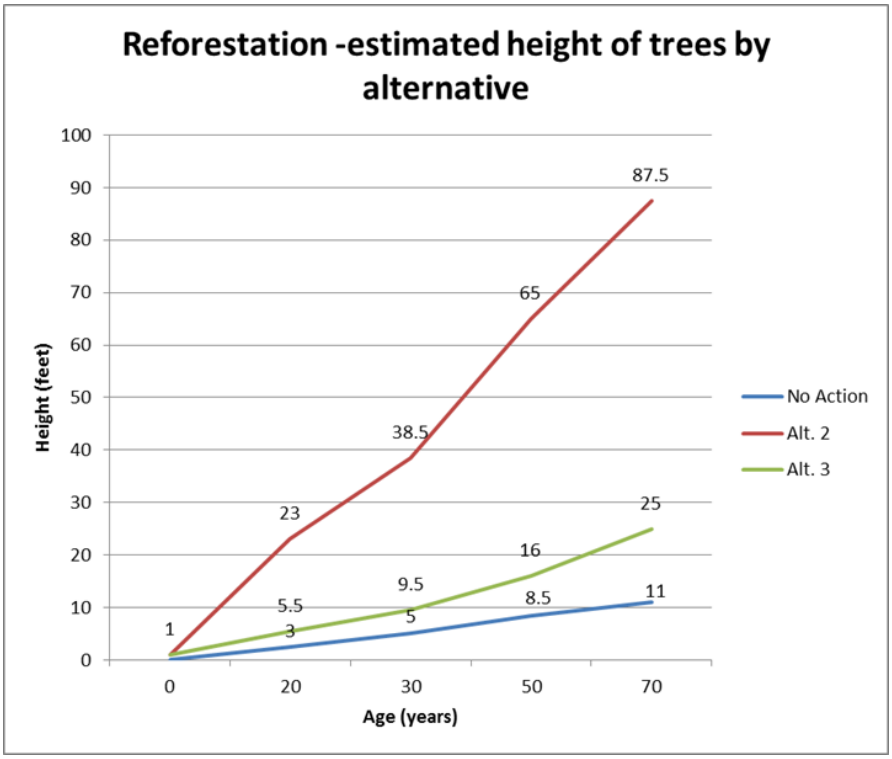


Figure 21. Graph displays the projected heights for Alternative 1 (No Action), 2, and 3 through age 70. Heights for planted trees in Alternative 4 and 5 would be similar to Alternative 2 since treatment within planted areas would be the same as Alternative 2 under those Alternatives.

Cumulative Effects

Indicator 1: Changes in Forest Structure related to Fire Severity

Alternative 3 would be less effective at bear clover/brush control and as a result fewer trees would be established. Trees would grow more slowly than planted trees in Alternative 2, 4, and 5. Hazard tree removal under Mile High Roadside Salvage project, BAER work and treatments proposed in Alternative 3 would be the same as Alternative 2. The result would be that cumulatively more acres of bear clover/brush CWHR types would be found in the Project area.

Indicators 2 and 3: Number of Trees per Acre and Basal Area Live and Dead; Hazard Tree Removal

Alternative 3 proposed the same acres of salvage of fire-affected trees, secondary salvage, hazard tree removal and planting as Alternative 2; hazard tree removal under the Mile High Roadside Salvage project, and BAER work in addition to treatments proposed with Alternative 3 would have the same cumulative effect as Alternative 2 for these indicators.

Indicator 4: Conifer reforestation, bear clover, and brush

Except for the exclusion of the application of herbicides, site preparation treatments would be the same for Alternative 3 as Alternative 2. The same areas (3,000 acres) would be planted in Alternative 3 as in Alternative 2. Alternative 3 would require the initial planting plus at least 2 additional almost total replantings to obtain close to minimal stocking. In addition, Alternative 3 would require at least 3 hand release treatments to increase the chances for seedling survival at marginal levels. At 20 years, following the initial planting and 2 subsequent re-plantings, only 50 to 100 trees (including oaks) would occupy the site. Bear clover and brush would occupy

the majority of the fire area. Growth rates of surviving trees are projected to be only about 25 percent of that projected under Alternative 2. Reforestation costs would be double that of Alternative 2. The effect of bear clover, brush and patchy dense conifer clumps found in high and moderate severity areas could conservatively result in it taking 125 to 150 years to return these areas to pre-fire "old forest" conditions "4M" structure depending on site conditions.

Table 26. Table displays dominance of conifers/oaks and bear clover/brush across the Project area under Alternative 3.

Vegetation dominance group	high and moderate severity post fire now brush dominated	proposed for conifer establishment ineffective bear clover/brush control – brush dominated	proposed for conifer establishment effective bear clover/brush control	Existing brush surviving fire	Low and very low severity with green intact tree cover	Total
Acres	6,419	2,600	400	413	4,000	13,832
Percent	46%	19%	3%	3%	29%	100%

Cumulative effects to snags and live trees are the same as Alternative 2. The majority of the high and moderate severity burn areas would be vegetated with bear clover and brush in Alternative 3. Much more bear clover and brush would be present in Alternative 3 than in Alternatives 2, 4 or 5 (Table 27). At age 20, only 50 to 100 trees per acre (including oaks) would occupy the site. Due to competition, trees in the reforested areas would be substantially smaller in diameter and height and would be at risk of loss due to wildfire for an additional 30 to 50 years longer than in Alternative 2 (Figures 20 and 21). An additional 50 to 75 years would be needed to obtain "old forest" conditions than in alternative 2. Reforestation costs would be twice that of alternative 2.

Due to ineffective control of bear clover/brush competition resulting in poor survival and growth and the excessive expenditures needed to implement Alternative 3, Alternative 3 does not meet the purpose and need to establish conifers and accelerate conifer growth.

3.6.6. Alternative 4 (Hazard Tree and Plantation Salvage Only)

Direct and Indirect Effects

Indicator 1: Changes in Forest Structure related to Fire Severity

Changes in CWHR result from altering live tree canopy cover or tree size. Since Alternative 4 does not remove live trees there are no direct effects to CWHR size or tree density classes. Pre-fire CWHR size and density within proposed treatment areas was predominately CWHR 4M and 4D.

Alternative 4 would not treat first entry or secondary entry areas except for those portions which overlap roadside hazard areas. 1,697 acres of primarily high fire severity burn areas, including approximately 300 acres of established plantations within 1.5 km of California Spotted Owl PACs, would not be treated under this alternative.

Approximately 2,400 acres of high and moderate fire severity patches would be reforested as a result of site preparation treatments (mastication, tractor pile, grapple pile, crush, jack pot burn, chemical and hand), planting, natural regeneration, and release treatments. Approximately 3,205 acres of conifer typed high and moderate severity burn areas would not receive treatments. Approximately 4,200 acres of high and moderate severity burn area oak or shrub dominated vegetation types would also not receive treatment to accelerate

growth. These untreated areas would develop tree and early seral stage brush cover in the same way as those described for the no action alternative.

The greatest treatment impacts to CWHR are from the establishment of conifers. Conifer reforestation would accelerate the growth and dominance of conifers on 2,400 acres. This is 30 percent of the 7,967 acres typed with a conifer component prior to the fire and 46 percent of conifer typed stands within the high/moderate severity burn areas. The CWHR type within these 2,400 acres would once again become dominated by conifers rather than brush. Size and canopy density are dominated by seedlings and saplings in the first 15 years (size 1 and 2). Secondary succession and resulting brush species would dominate 2,814 acres of the pre-fire conifer CWHR types within the high and moderate fire severity burn areas. The greatest landscape impacts to CWHR tree size and density classes occur as a result of the French Fire and secondary succession, not from proposed treatments.

Indicator 2: Number of Trees per Acre and Basal Area Live and Dead

The direct and indirect effects of hazard tree removal and plantation salvage treatments would be the same as in Alternative 2. The direct and indirect effects of not salvaging within first entry and secondary entry stands would be the same as the No Action Alternative 1 for those areas.

Alternative 4 would only treat about 3,513 acres of roadside hazard areas and 514 acres on plantations. Of the 3,513 acres of roadside hazard treatments, the outer 150 feet on each side of treated roads would only remove hazards to the road. All other snags would remain posing a safety threat to forest workers and the public as well as a source for increased fuel loading after snag fall.

Over all vegetation types (13,832 acres), Alternative 4 would treat up to 4,333 gross acres (plantations, roadside hazards, powerline right-of-way, DFPZs and medusahead infestations). 9,499 acres would not be treated.

All snags would remain in the non-treatment areas, approximately 0 snags per acre would remain within the DFPZs and SCE powerline corridor, 0 snags per acre would remain within the first 150 feet of the roadside hazard treatment areas and 20 snags per acre would remain in the outer 150 feet of the roadside hazard treatment areas. Approximately 24.9 snags per acre would remain in areas outside proposed treatment areas (Otto 2015 Wildlife B.A.).

Reforestation efforts would establish approximately 200 trees per acre over 2,400 acres for a total increase in tree numbers of approximately 480,000 trees, including sprouting oaks, 10 years after the French Fire. Large acreages of high severity burn areas, most in need of reforestation, would not be reforested with this alternative. Reforestation efforts would be concentrated within the roadside hazard treatment areas and plantations.

Since only plantations and the first 150 feet of the roadside hazard treatment areas would remove the majority of snags with this alternative, most snags within the French Fire area would remain. Alternative 4 meets the purpose and need for snag habitat. Alternative 4 accelerates conifer growth on approximately 17 percent of total Project acres typed with a conifer component, and 46 percent of high and moderate fire severity conifer typed areas.

Indicator 3: Hazard Tree Removal

Under Alternative 4, roadside hazard tree removal treatments would occur along the same roads as in Alternative 2. In addition to plantation roadside treatment areas, 3,513 acres (gross) would be treated with this alternative. Alternative 4 would treat hazards along all roads. More than one hazard tree removal entry may be necessary in order to treat roadside hazard trees as additional hazard trees appear due to the drought, insects and the lingering effects of fire. Roadside hazard tree removal, however, would not remove hazards to forest workers in the outer 150 feet of the roadside hazard tree treatment areas if the snags were not a hazard to the road. These snags would remain a hazard to workers and the public as well as a source for increased fuel loading after snag fall.

The direct and indirect effects described in Alternative 2 for hazard tree removal are the same for Alternative 4.

Indicator 4: Conifer reforestation, bear clover, and brush

The direct and indirect effects described in Alternative 2 for reforestation in roadside hazard, and plantations being treated under Alternative 4 are the same as Alternative 2. First entry treatment areas were planned to use roads for treatment boundaries where fire burn severity was similar. The roadside hazard treatments would treat these overlapping areas with Alternative 4. However, changing the prescription from a first or secondary entry prescription to a hazard tree prescription would result in the retention of additional snags in the outer 150 feet. Site preparation and planting would be undertaken within this zone. However, these additional snags will present a safety hazard for forest workers during site preparation, planting and stand maintenance treatments as well as increase future fuel loading as snag fall occurs.

Plantations within secondary entry areas would be treated under this alternative. Secondary entry areas that overlap with roadside hazard areas would also be treated as roadside hazard areas.

Alternative 4 would treat approximately 1,697 fewer acres than Alternative 2. Due to draws, poor site, archaeological sites, etc., approximately 15 to 20 percent of the secondary treatment area gross acres would likely not be treated once actual treatment areas are delineated on the ground.

This alternative would treat about 30 percent fewer acres, but is estimated to reforest approximately 20 percent fewer acres. No reforestation would be accomplished in any of the 1,697 mostly high fire severity burn acres, including 300 acres of established plantations, not treated under this alternative. Large patches of high severity burn areas would not be reforested with this alternative. The direct and indirect effects for these non-treatment areas would be the same as described in Alternative 1. Bear clover and brush would dominate those stands.

Cumulative Effects

Indicator 1: Changes in Forest Structure related to Fire Severity

Cumulative effect of Alternative 4 treatments, existing hazard tree decisions, and BAER treatments combined maintains green forest structure where present except for incidental removal near log landings and scattered green hazard trees within the treated stands.

Hazard tree removal will remove some green unstable trees. Plot data indicates that trees are scattered and widely separated across the fire area. Changes from green hazard tree removal have no effect on CWHR density or class and do not result in a cumulative effect on CWHR.

Indicator 2: Number of Trees per Acre and Basal Area Live and Dead

The direct and indirect effects of alternative 4 include the effects of the Mile High Salvage project as well as BAER areas. The cumulative effects for vegetation are examined at the project scale therefore the cumulative effects for this indicator are the same as for the Project.

Indicator 3: Hazard Tree Removal

Alternative 4 would remove hazardous trees from 3513 acres along roads. Most, approximately 90 per cent, would be removed within the first 150 feet of roadways. An estimated 20 snags per acre would remain standing in the outer 150 feet following treatment. Hazard trees within initial and secondary treatment areas and plantations would be removed during implementation. Trees hazardous to the public within roadside hazard treatment areas would be removed under this alternative while retaining estimated average 16.4 snags per acre across the Project area following implementation of alternative 4 and the Mile High Salvage project. However, trees hazardous to forest workers in the outer 150 feet would not be removed.

Indicator 4: Conifer reforestation, bear clover, and brush

Under alternative 4, planting would occur within high and moderate burn severity hazard tree removal areas vegetated with conifers prior to the French Fire and plantations. The Mile High Salvage project area is included within the Project treatment areas. Planting within the Mile High treatment areas as well as BAER areas would be undertaken during planting of the remainder of the French Fire treatment areas. Oak and shrub vegetation types with high and moderate severity would also be dominated by bear clover/brush. Table 26 displays the dominance of conifers/oaks and bear clover/brush across the Project area under alternative 4. Non treatment areas, oak and shrub vegetation types would be dominated by bear clover/brush for 20 to 50 years or longer. Approximately 9,419 acres burned at high and moderate severity killing most vegetation and creating bear clover/brush dominated conditions. Of the 13,832 acres within the French Fire, approximately 7,019 acres across the Project area with high and moderate fire severity would be dominated by early seral bear clover/brush species, up to 2,400 acres are proposed for conifer reforestation, and 4,420 acres would have a mosaic of green tree cover and openings on low and very low (RAVG 0-25% basal area mortality—39% mortality—plot data) severity acres. The reforested acres would be dominated by conifers within 5 to 10 years after plantation establishment. Near the fringes of planted areas planted trees will play a future roll in seedling reestablishment beyond the planting boundary. As these planted trees reach cone bearing age, planted trees will be able to provide a seed source for some of the areas remaining with few established conifers. However, this alternative does not treat 1,697 acres of predominately high severity burn areas. Due to a lack of nearby seed trees and no reforestation efforts with this alternative, the cumulative effects in these non-treatment areas will be similar to No Action Alternative 1. The cumulative effect of Alternative 4 treatments, hazard tree removal with current decisions, and brush growth is a landscape with 51 percent of the acres dominated by early seral bear clover/brush species, 17 percent dominated by young conifer plantations created by Alternative 4, and 32 percent with a mosaic of green tree structure and openings.

Table 27. Table displays the dominance of conifers/oaks and bear clover/brush across the Project area with Alternative 4.

Vegetation dominance group	High and moderate severity post fire now bear clover/brush dominated	Proposed for conifer establishment effective bear clover/brush control	Existing brush surviving fire	Low and very low severity with green intact tree cover	Total
Acres	7,019	2,400	413	4,000	13,832
Percent of Project	51%	17%	3%	29%	100%

Conclusion:

Alternative 4 only treats roadside hazard areas and plantations that are more than 1.5 km from California Spotted Owl PACs. 1,697 acres of predominately high severity burn areas would not be treated under this alternative. Fuel reduction and reforestation treatments would not be implemented in these 1,697 acres. 300 acres of previously established plantations would not be reforested.

The Mile High Roadside Salvage project along Road 4S81 and BAER work combined with proposed treatments in Alternative 4 result in17 percent of the Project area being treated to recreate forested conditions to capture greenhouse gases and accelerate “old forest” desired structures (Table 28). Hazard trees are effectively removed and provide safe roadways. Snag objectives are met across the Project area. Tree numbers increase rapidly with treatments on 17 percent of the landscape while retaining approximately 51 percent of the Project area dominated by early seral bear clover/brush. Fuel loads and brush continue to pose a high fuels hazard across

1,696 acres more than Alternative 2. The effects of the French Fire have the greatest impacts on vegetation and trends in conifer dominance over the Project area even with treatments proposed in alternative 4.

As a result, Alternative 4 meets SNF LRMP S&G 14 to generally not conduct salvage harvest in 10 percent of the total area. Alternative 4 leaves untreated approximately70 percent of the Project area, which is much more than the 10 percent desired to be left untreated under S&G 14.

Alternative 4 treats 30 percent less acres than Alternative 2. Although Alternative 4 appears to reforest only 20 percent fewer acres than Alternative 2, the 3,000 acres proposed for reforestation in Alternative 2 would be those most in need of reforestation. Many of those acres would be within the high burn severity areas not being treated in Alternative 4. Implementation of Alternative 4 would result in reforestation of some areas not in as great need of reforestation as those that would be treated in Alternative 2.

The French Fire experienced some very large areas of high and moderate to high severity patches (Figure 2). Some are 1 to 2 miles long by ½ mile wide. Alternative 2 would treat these areas, while alternative 4 would not. The cumulative effects for these untreated areas under alternative 4 would be similar to the no action alternative 1.

1,697 acres would not be treated under Alternative 4 and would remain dominated by bear clover and brush. Reforestation treatments would be substantially less than Alternative 2. Alternative 4 meets the purpose and need to establish conifers and accelerate conifer growth however to much lesser extent than alternative 2. Alternative 4 meets SNF LRMP S&G 12 to promote shade intolerant pines (sugar and ponderosa) and hardwoods however to a much lesser extent than alternative 2. It also promotes the establishment of blister rust resistant sugar pine.

3.6.7. Alternative 5 (No Secondary Entry)

Direct and Indirect Effects

Indicator 1: Changes in Forest Structure related to Fire Severity

Changes in CWHR result from altering live tree canopy cover or tree size. Since Alternative 5 does not remove live trees there are no direct effects to CWHR size or tree density classes. Pre-fire CWHR size and density within proposed treatment areas was predominately CWHR 4M and 4D.

Approximately 2,900 acres of high and moderate fire severity patches would be reforested as a result of site preparation treatments (mastication, tractor pile, grapple pile, crush, jack pot burn, chemical and hand), planting, natural regeneration, and release treatments. Approximately 2,705 acres of conifer typed high and moderate severity burn areas would not receive treatments. Approximately 4,200 acres of high and moderate severity burn area oak or shrub dominated vegetation types would also not receive treatment to accelerate growth. These untreated areas would develop tree and early seral stage brush cover in the same way as those described for the no action alternative.

Indicator 2: Number of Trees per Acre and Basal Area Live and Dead

Under Alternative 5, treatments within first entry treatment areas would be the same as alternative 2 except u33m and u53m would not be treated (total 10 acres). In addition, u47m, u453, and portions of u52m would not be treated (total 37 acres). Appendix A (Section 6.1.5 Alternative 5 Map B) contains a map of these specific units within the Project area. Direct and indirect effects for the first treatment areas would be the same as alternative 2. The direct and indirect effects for the previously listed units not being treated and the secondary entry treatment units would be the same as alternative 1.

Alternative 5 would treat approximately 490 fewer acres (approximately 8 percent fewer acres) than alternative 2.

Indicator 3: Hazard Tree Removal

Under alternative 5, roadside hazard tree removal treatments would occur along the same roads as in alternative 2. In addition to first entry and plantation treatment areas, 2,773 acres (gross) would be treated with this alternative. The direct and indirect effects described in alternative 2 for hazard tree removal are the same for alternative 5.

Indicator 4: Conifer reforestation, bear clover, and brush

The direct and indirect effects described in alternative 2 for reforestation in the first entry areas, roadside hazard, and plantations being treated under alternative 5 are the same as alternative 2.

Plantations within secondary entry areas would be treated under this alternative. Secondary entry areas that overlap with roadside hazard areas would also be treated as roadside hazard areas.

Alternative 5 would treat approximately 490 fewer acres than alternative 2. Due to draws, poor site, archaeological sites, etc., approximately 15 to 20 percent of the secondary treatment area gross acres would likely not be treated once actual treatment areas are delineated on the ground.

This alternative would treat about 8 percent fewer gross acres, but is estimated to reforest approximately 3 percent fewer acres. However, no reforestation would be accomplished in any of the 490 acres not treated under this alternative. Bear clover and brush would dominate those stands. Approximately 47 to 50 acres of previously established pine plantations would not be reforested under this alternative.

Table 28. Table displays the dominance of conifers/oaks and bear clover/brush across the Project areas with Alternative 5.

Vegetation dominance group	High and moderate severity post fire now bear clover/brush dominated	Proposed for conifer establishment effective bear clover/brush control	Existing brush surviving fire	Low and very low severity with green intact tree cover	Total
Acres	6,519	2,900	413	4,000	13,832
Percent of Project	47%	21%	3%	29%	100%

Cumulative Effects

Indicator 1: Changes in Forest Structure related to Fire Severity

The cumulative effects for Alternative 5 would be the same as Alternative 2 except no secondary entry treatments would be implemented and u33m and u53m would not be treated (total 10 acres). In addition, u47m, u453, and portions of u52m would not be treated (total 37 acres). The cumulative effects for the secondary entry treatment areas in Alternative 5 and the 37 acres of plantations would be the same as the No Action alternative 1.

Indicator 2: Number of Trees per Acre and Basal Area Live and Dead

The cumulative effects for Alternative 5 would be the same as Alternative 2 except no secondary entry treatments and no treatments in u33m and u53m (total 10 acres) would be done. In addition, u47m, u453, and portions of u52m would not be treated (total 37 acres). The cumulative effects for the secondary entry treatment areas in Alternative 5 and the 37 acres of plantations would be the same as the No Action alternative 1.

Indicator 3: Hazard Tree Removal

The cumulative effects for Alternative 5 for roadside hazard tree removal would be the same as those for Alternative 2.

Indicator 4: Conifer reforestation, bear clover, and brush

The cumulative effects for Alternative 5 for conifer reforestation would be the same as for Alternative 2 except no reforestation treatments would be implemented within secondary treatment areas except for the roadside hazard treatment areas and plantations. Snags that are not a hazard to roads in the outer 150 feet of the roadside hazard areas within the secondary treatment areas would remain and pose a hazard to forest workers and the public as described in Alternative 4. Alternative 5 meets SNF LRMP S&G 12 to promote shade intolerant pines (sugar and ponderosa) and hardwoods however to a lesser extent than Alternative 2. It also promotes the establishment of blister rust resistant sugar pine.

Conclusion:

See Table 10 for a reforestation comparison between alternatives.

Alternative 5 would treat all the first entry areas and plantations that would be treated in alternative 2 except for 50 acres. It would not treat secondary treatment areas except for portions that overlap roadside hazard areas.

The Mile High Roadside Salvage project along Road 4S81 and BAER work combined with proposed treatments in alternative 5 result in 21 percent of the Project area being treated to recreate forested conditions to capture greenhouse gases and accelerate “old forest” desired structures (Table 26). Hazard trees are effectively removed and provide safe roadways. Snag objectives are met across the Project area. Tree numbers increase rapidly with treatments on 21 percent of the landscape while retaining approximately 50 percent of the Project area dominated by early seral bear clover/brush. Fuel loads and brush continue to pose a high fuels hazard across 490 acres more than alternative 2. The effects of the French Fire have the greatest impacts on vegetation and trends in conifer dominance over the Project area even with treatments proposed in alternative 5.

In summary, alternative 5 retains approximately 41 percent of the high and moderate severity acres untreated and retains more than 61 percent of the project area affected by fire unharvested. As a result, alternative 5 meets SNF LRMP S&G 14 to generally not conduct salvage harvest in 10 percent of the total area. Alternative 5 leaves untreated approximately 61 percent of the Project area, which is far more than the 10 percent desired to be left untreated under S&G 14.

In those areas where reforestation treatments are implemented survival and growth of planted trees will be similar to Alternative 2.

Alternative 5 treats 10 percent fewer acres than alternative 2. Although alternative 5 appears to reforest only 4 percent fewer acres than alternative 2, the 3,000 acres proposed for reforestation in alternative 2 would be those most in need of reforestation. Areas most in need of reforestation within the 490 acres of secondary treatment areas that would not treated under this alternative would need to rely upon natural regeneration. Implementation of alternative 5 would result in secondary treatment areas obtaining “old forest” conditions 50 to 75 years later than in alternative 2. Implementation of alternative 5 would result in reforestation of some areas not in as great need of reforestation as those that would be treated in alternative 2.

The French Fire experienced some very large areas of high and moderate to high severity patches (Figure 2). Some are 1 to 2 miles long by ½ mile wide. Alternative 2 would treat these areas. Alternative 5 would not treat the secondary treatment areas within these patches. The cumulative effects for these untreated areas under Alternative 5 would be similar to the no action alternative 1.

Alternative 5 does not meet the purpose and need to establish conifers and accelerate conifer growth as fully as alternative 2.

3.7. Herbicide Use

3.7.1. Background and Affected Environment

This section addresses concerns expressed by the public during scoping that the use of herbicides poses a health risk to humans and wildlife. Four chemicals would be used as described in the Proposed Action: glyphosate herbicide, R-11 surfactant, Colorfast® purple dye, and borax fungicide. Thus though this section is titled "herbicide use" it covers the adjuvants that are mixed with the herbicide, and the fungicide used to treat annosum root disease in conifers (all classified as "pesticides" by the Forest Service). The initial Proposed Action in October 2014 included aminopyralid herbicide and Agri-Dex surfactant; these two chemicals have since been dropped from consideration for this Project.

Effects to human health or the environment from the use of any pesticide depends on the toxic properties (hazards) of the herbicide, the level of human and/or animal exposure to the pesticide, and the duration of that exposure. In other words, there are many variables, including those listed above, to be considered when evaluating risk to health and the environment from pesticide use. Since 1995, the Forest Service has contracted with Syracuse Environmental Research Associates, Inc. (SERA) to prepare in-depth risk assessments for pesticides commonly used on NFS lands. These risk assessments are available at http://www.fs.fed.us/foresthealth/pesticide/risk.shtml and are meant to be directly incorporated by reference for project-level NEPA or used to prepare project-level risk assessments. SERA risk assessments also evaluate potential hazards of impurities, metabolites, and inert ingredients.

A project-level Human Health Risk Assessment (Risk Assessment) was completed to evaluate the hazard posed by the chemicals proposed for use in the Project area (USDA Forest Service, 2015). This Risk Assessment and the EA used the in-depth Forest Service risk assessments for glyphosate (SERA, 2011) and Borax (SERA, 2006); these documents are incorporated by reference and are available in the Project Record and on line at the link shown above. For R-11 and Colorfast Purple dye, risk assessments prepared by Region 5, Forest Service were used (USDA Forest Service, 2003; 2007); these are also incorporated by reference and can be found online at http://www.fs.usda.gov/detail/r5/forest-grasslandhealth/?cid=fsbdev3_046692.

As described in Chapter 2, pesticides would be applied within the Project area for reforestation, DFPZ maintenance, invasive weed control, and to treat annosum root disease (Borax) in developed recreation areas. The Project has been carefully designed to minimize or eliminate risks to human health and the environment from the application of pesticides (see Section 2.1.6, Design Criteria).

Please see the Risk Assessment for Project details and Project-specific worksheet results for glyphosate and R-11. Worksheets can be viewed on the USFS pesticide use website (http://www.fs.fed.us/foresthealth/pesticide/worksheets.shtml). The worksheets were used to perform computer-based project specific (site-specific) calculations that incorporated the characteristics of the Project including chemical formulation, use rate, and site factors.

Herbicide terminology and exposure level definitions include: reference dose (Rfd) refers to the EPA's maximum acceptable oral dose of a toxic substance; hazard quotient (HQ) refers to the ratio of a measure of exposure to a substance and a measure of the effect of that substance; active ingredient (a.i.) of a herbicide is the amount of chemical that is actually creating the effects that are present in a commercial formulation. For the glyphosate brands recently used by the Sierra NF (Accord, Rodeo, Aquamaster); there are 5.4 lbs a.i per gallon of product (this is different from gallons of mix, which is much more dilute). The label for glyphosate also gives the acid equivalent (a.e.), which in this case is 4 lbs a.e. per gallon. Acid equivalent is used in the Forest Service Risk Assessment worksheet calculations, but a.i. is more commonly used in everyday language.

Glyphosate

Glyphosate is a non-selective herbicide that is registered for forestry applications and control of invasive plants (among other uses) by the EPA. The herbicidal activity of glyphosate is due primarily to the inhibition of an enzyme involved in the synthesis of aromatic amino acids that are essential for plant growth. This metabolic pathway does not occur in humans or other animals (SERA 2011).

In 1991, US EPA concluded that glyphosate should be classified as a Group E (evidence of non-carcinogenicity for humans) based on a lack of convincing carcinogenicity evidence and considering the criteria in EPA Guidelines for classifying a carcinogen. Based on an evaluation of the available animal studies as well as epidemiology studies, U.S. EPA/OPP (2002, p. 60943) classifies the carcinogenic potential of glyphosate as Group E, No Evidence of Carcinogenicity. Given the marginal mutagenic activity of glyphosate, the failure of several chronic feeding studies to demonstrate a dose-response relationship for carcinogenicity, and the limitations in the available epidemiology studies on glyphosate, the Group E classification in U.S. EPA/OPP (1993a, 2002) appears to be reasonable.

Recently, the International Agency for Research on Cancer (IARC) Monograph Working Group determined that glyphosate should be classified as "probably carcinogenic to humans" (Guyton et al 2015). This determination was based on a review of existing studies and not on new research. The issue is a particular group of cancers called non-Hodgkin's lymphomas. The Guyton 2015 paper is only a summary of a longer paper that is in-press at this time. In a few months, US EPA will be releasing for public comment their preliminary human health risk assessment for glyphosate as part of their program to reevaluate all pesticides periodically (EPA 2009). Please reference the Project Risk Assessment in the Project Record for more information.

It has been USFS practice to defer to US EPA unless there is a compelling reason to do otherwise. At this point, there is not yet a compelling reason to adopt the IARC's classification since all the technical details are not yet available from IARC and since US EPA's and our analyses would indicate a different conclusion. As stated, a new risk assessment from US EPA is expected later this year which will undoubtedly consider the IARC's classification. If the US EPA accepts the IARC recommendation, then the USFS would consider an update to the glyphosate RA and for purposes of existing NEPA documents, such a reclassification would be considered 'new information'.

R-11®

R-11® is a mixture of the soap nonylphenol polyethoxylate (NP9E), about 10% butyl or isopropyl alcohol, about 1% silicone de-foamer, and water. Typically, the application rate for R-11® is about 0.2 gallons of active ingredient (a.i.)/acre when used at a 1% dilution rate. Further information is available in the Project Risk Assessment.

Colorfast® Purple Dye

The active ingredients in Colorfast Purple are acetic acid, dipropylene glycol, and Basic Violet 3 (SERA 1997b). The exact amounts of the ingredients in this product are considered proprietary. Acetic acid, a major component of vinegar, is on the EPA's list 4A of inerts. Dipropylene glycol is on EPA's list 3 of inerts. None of the ingredients in this product are known to be on EPA List 1 or 2. Basic Violet 3 dye is the colorant in Colorfast Purple. Most of the information about its toxicological effects is attributed to the chloride salt, commonly referred to as Gentian Violet. Gentian Violet is used as an antifungal agent, a treatment for oral infections, and as laboratory reagent and stain (SERA, 1997b). Based on the MSDS no toxic chemicals are present that are subject to the reporting requirement of the Emergency Planning and Community Right-to-Know Act (EPCRA, also referred to as SARA Title III) and 40 CFR 372 (Toxic Chemical Release Reporting:

Community Right-to-Know). In a Study by Littlefield et al (in SERA, 1997b) marked carcinogenic activity was observed in mice, and is the basis for a qualitative cancer risk assessment in SERA (1997b).

Borax

Sodium tetraborate decahydrate (borax, Sporax) is used by the Forest Service to slow the development of annosum root disease in conifer stands. Borax is typically applied to cut stumps of conifer trees, at an average rate of 1 lb/acre. It is classified as a moderately toxic substance in acute studies and is considered more active via oral inhalation compared to dermal exposure. The SERA risk assessment (2006) concluded that based on their analysis of exposure scenarios, there is no basis for asserting that systemic toxic effects to workers or the general public would result from either acute or longer-term exposures, except by direct consumption. It is the same compound as the laundry detergent by the same name (Borax).

3.7.2. Environmental Consequences

3.7.3. Alternative 1 (No Action)

Direct and Indirect Effects

There would be no effects from herbicides, adjuvants, or fungicides to humans or wildlife because there would be no chemical treatments under alternative 1.

3.7.4. Alternative 2 (Proposed Action)

The risk of harm to human health or the environment due to herbicide applications would be slightly higher under alternative 2 than under alternatives 4 or 5; because more acres would be sprayed (2600 for site prep, 450 for release); and no-spray buffers above 5000’ elevation for Yosemite toad and Sierra Nevada yellow legged frog would be 125’ total rather than 600’ total as for alternatives 4 and 5. The no spray buffers and limited operating periods are designed for a “no effect” for listed and sensitive amphibians in alternative 2. Alternatives 4 and 5 provide extreme precaution by increasing the no spray buffer to 600 feet. The risk of unintended harm to humans or the environment is higher than alternatives 1 or 3, as neither of these incurs any risk of herbicide exposure or effects as none would be used. Invasive weed and DFPZ treatments with glyphosate would be the same as in alternatives 4 and 5, Borax treatments are the same under all action alternatives.

Direct and Indirect Effects

Human Health and Safety

Glyphosate

Concerns have been expressed in the past that herbicides might leach through the soil and reach drinking water supplies. The following information on water and soil movement is also relevant to environmental risk:

According to a review of studies by Ghassemi and others (1981) glyphosate rapidly attaches to organic matter on top of or in the soil and its mobility is very limited. Because of its very low mobility in soil the only mechanism for off-site movement of glyphosate would be if it was attached to soil particles that were eroded and transported to another location. Normal hydrolysis in a stream will not break the attachment of glyphosate to soil particles. So, even if the combination reached the water, it would not be in a form that can be taken up by plants or released through digestion by animals, and would not affect either surface or ground water quality. Project Design Criteria ensure that spraying would not occur directly prior to or during a rain event nor would it occur when wind speeds are greater than 7 mph. Thus, the likelihood of soil particles with glyphosate attached

to them moving off-site into water are practically nonexistent, especially given that spraying would not occur within 100 feet of water.

The greatest risk of introducing glyphosate into water would be by accidental spills. This risk would be minimized by implementation of Design Criteria and BMP 5.11 which would limit transportation of herbicides to designated routes and specify batching and mixing locations and BMP 5.10 which provides for a Spill Contingency Plan.

Forest Service water quality monitoring data from 1991-1999 adjacent to projects where glyphosate was applied revealed no detections of glyphosate in water for ground-based treatments outside of riparian zones (Bakke 2001). Over 100 samples were tested over that time span in 8 national forests in Region 5. These results are expected based on the low mobility in soil described above.

The hazard characterization, the application method (backpack spraying), and the number and characteristics of people that could come in contact with glyphosate is similar to many other projects undertaken by the Ranger District in recent years.

Glyphosate is considered to be slightly toxic to humans. It is non-irritating to the skin and only slightly irritating to the eyes. There is no evidence that glyphosate causes birth defects, neurotoxicity, immunotoxicity or endocrine disruption (SERA 2002 & 2003).

As stated above, a Risk Assessment to determine the site-specific risks to human health and safety of using the herbicide glyphosate was prepared for the Project and is incorporated by reference.

R-11®

Like glyphosate, R-11 is broken down by soil microorganisms. The main breakdown product is carbon dioxide (Information Ventures, Inc., 1994-2005). The mixture is slightly toxic to practically non-toxic to mammals.

Eye irritation and skin sensitization are likely effects of mishandling R-11® as would be the case with any soap. Synergistic effects of glyphosate and/or R-11 with other chemicals are not anticipated in the project area because they have not occurred when used extensively in other forestry or invasive weed applications.

At typical application rates (1%), there is no evidence that R-11® causes birth defects, cancer, neurotoxicity or immunotoxicity (USDA Forest Service 2003). Please see the Risk Assessment for further details. The material safety data sheet (MSDS), label, and product sheet are available at: http://ag.wilburellis.com/Products/Pages/R-11.aspx.

For the public, acute or accidental exposure scenarios involving consumption of contaminated water, consumption of contaminated vegetation, or subsistence consumption of fish represent some risk of effects. None of the other acute exposure scenarios represent a risk of effects to the public from R-11 exposure. At typical rates of application, the drinking of contaminated water after a spill could present a risk of subclinical effects to the liver and kidney. The exposure scenario for the consumption of contaminated water is an arbitrary scenario: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. The consumption of contaminated vegetation also represents a risk of clinical effects at the high application rates only. At the typical rate of application, the risk is considered acceptable. Nonetheless, this and other acute scenarios help to identify the types of scenarios that are of greatest concern and may warrant the greatest steps to mitigate. For NP9E surfactants including R-11®, such scenarios involve oral rather than dermal exposure.

Colorfast® Purple Dye

Two sources were used to assess risk for Colorfast Purple dye: A report by R5 Pesticide Use Specialist Dave Bakke entitled: “Consideration of Cancer Risk with Colorfast Purple Dye” (Bakke 2000) and “Use and

Assessment of Marker Dyes Used with Herbicides" by SERA (1997b). Please reference the Project Risk Assessment for R5 calculations for worker safety when this dye is used at rates proposed for this Project.

Based on SERA, 1997b, risk characterization leads to typical cancer risks for workers of 4.7×10^{-7} or 1 in 2.1 million. For the public, the consumption of sprayed berries yielded an estimated single exposure risk of 1 in 37 million to 1 in 294 million. For public exposures, it is expected that the dye would reduce exposures both to itself and to the other chemicals it might be mixed with (herbicide and other adjuvants) as the public would be alerted to the presence of treated vegetation.

Borax

Unlike most other risk assessments on pesticides used by the Forest Service, the agent of toxicological concern in borax – i.e., boron – occurs naturally and exposures to boron are unavoidable. Boron occurs in water, soil, and air; as well as plants and animals, including humans. Except for the most extreme exposure scenario considered in the SERA (2006) risk assessment – i.e., the direct consumption of borax from a tree stump by a child – the use of borax in Forest Service programs would not substantially contribute to boron exposures in humans.

Environmental and Ecological Risk

Glyphosate

Glyphosate in less toxic formulations (e.g. with R-11 rather than the surfactant originally used in Roundup) poses almost no risk to terrestrial organisms and only poses a discernible risk to aquatic organisms at application rates over 3.4 lbs of active ingredient /acre; see Ecological Risk Assessment in the SERA (2011) document.

Reregistration Eligibility Decision from EPA provides insight into the toxicity of glyphosate. Highlights from EPA (1993) are "Glyphosate is no more than slightly toxic to birds and is practically non-toxic to fish, aquatic invertebrates and honey bees." (p. 4) and "Based on current data, EPA has determined that the effects of glyphosate on birds, mammals, fish and invertebrates are minimal." (p. 5). Studies of the toxicity of glyphosate to amphibians at higher applications rates than proposed here, resulted in much lower Hazard Quotients than the established threshold of concern. Please see the Risk Assessment for toxicology details from exposure studies for terrestrial invertebrates, fish, and amphibians.

Under alternative 2, effects to water quality and aquatic wildlife species from the use of glyphosate are not expected to occur because with the project Design Criteria, herbicides would not be applied to or within 100' of open water.

R-11®

There is little risk to terrestrial wildlife at any application rate considered in the Region 5 2003 risk assessment. With typical application rates, two scenarios represent a slight risk of effects to mammals: direct spray to a small mammal (assuming the skin affords no protection) and consumption of contaminated vegetation by a large grazing mammal, such as a deer. None of the other acute exposures at the typical rates of application represent a risk of effects to terrestrial wildlife. At the highest application rates, acute exposures from the consumption of contaminated vegetation present a risk of effects, assuming 100% of consumed vegetation is contaminated. If we assume the skin is not a barrier at all (100% absorption), then the direct spray also provides a risk of effects at the highest application rates.

For aquatic species, the duration of any exposure would be short if R-11 actually reached the water, which is unlikely with Project Design Criteria; the compounds of concern are broken down and their concentration reduced through dilution, as well as binding of the compounds to stream sediments.

The ambient levels of R-11 assumed to be present from normal operations would not pose harm to aquatic organisms (USDA Forest Service, 2003). Please see the Risk Assessment for further toxicology details.

Colorfast® Purple Dye

There could be occasional direct effects if a small animal were accidentally sprayed; but the limited duration of potential effects (spraying one or two times over a five or six year period for reforestation and DFPZs and twice a year at most for invasive weeds and for a few minutes any given site) is considered a reasonable risk.

Borax

The use of borax in Forest Service programs would not typically or substantially contribute to concentrations of boron in water or soil (SERA 2006).

Cumulative Effects for Human health for all pesticides

Cumulative doses of glyphosate and/or R-11 could result from either various routes of exposure from the Project or from additive doses from other herbicide treatments. However no other herbicide treatments are planned for the foreseeable future by the Forest Service.

Additive doses from various routes of exposure from the project (i.e. eating contaminated fruit and drinking contaminated water on the same day) can be estimated from the tables of exposure rates in the SERA and R5 risk assessments. The two doses would be added and divided by the RfD to determine the HQ. The calculated HQ for a combined dose for any two routes of exposure would still show no cause for concern and an acceptable risk to human health and safety.

Other sources of additive exposure could include glyphosate and/or R-11 used on adjacent lands, re-treatment of the same site in the same or following years, and home use by a worker or member of the general public. In the Project area, there are no adjacent private landowners or government agencies that have used or plan to use large amounts of herbicides to our knowledge.

For reforestation and DFPZs, in most instances only one herbicide application would be made. A second application may be made in a following year in those areas where the first was not successful or for release. For invasive weeds (primarily medusahead, which occurs over far less than 32 gross acres, there may be two treatments per year for up to 6 years, but each year the amounts applied would be lower as the medusahead responds to treatment. Doses are not expected to be additive because soil microorganisms break down glyphosate and R-11 and no residual chemical would remain on site from a previous years's treatment.

Should workers or members of the public apply glyphosate and/or R-11 at home, they would receive doses approximately equal to those estimated for this Project, assuming similar rates and application methods are used, per manufacture's label direction. If this exposure occurred on the same day as the project exposure, then the two doses would be added and divided by the RfD to determine the HQ. The calculated HQ for a combined dose for any two routes of exposure would still show no cause for concern and an acceptable risk to human health and safety.

There is no indication that glyphosate causes sensitization or allergic responses, which does not eliminate the possibility that some individuals might be sensitive to glyphosate as well as many other chemicals (SERA 2003; 3-51). As stated earlier, eye irritation and skin sensitization are likely effects of mishandling R-11 as would be the case with any soap.

Synergistic effects of glyphosate and/or R-11 with other chemicals are not anticipated in the Project area because they have not occurred when it has been used extensively in other forestry and agricultural applications.

For Borax, interpretation of the SERA risk assessment (SERA 2006) indicates that cumulative effects from treatment of stumps (in recreation areas only) would be extremely unlikely to result to human health or to terrestrial or aquatic wildlife.

For all worker and public exposure scenarios, cumulative effects would be negligible

3.7.5. Alternative 3 (No Herbicide)

Direct and Indirect Effects

Effects would be similar to Alternative 1 as no herbicides or adjuvants would be used. Effects would be similar to alternative 1 as no herbicides or adjuvants would be used. Borax fungicide would be applied in developed recreation areas under all action alternatives, as per Regional policy (FSM 2303 – USDA Forest Service 1992x).

3.7.6. Alternative 4 (Hazard Tree and Plantation Only)

Direct and Indirect Effects

Risk of harm to human health or the environment would be lower than for alternative 2 because fewer acres would be sprayed (2000 for site prep, 300 for release); also no-spray buffers above 5000' elevation for Yosemite toad and Sierra Nevada yellow legged frog would be 500' (600' total distance from stream or meadow) rather than 125' total under alternative 2. Invasive weed and DFPZ treatments with glyphosate would be the same as in alternative 2; and Borax treatments would remain the same as well.

Cumulative Effects

Cumulative effects are the same as for alternative 2.

3.7.7. Alternative 5 (No Secondary Entry)

Direct and Indirect Effects

Risk of harm to human health or the environment would be lower than for alternative 2 because slightly fewer acres would be sprayed (2500 for site prep, 400 for release); also no-spray buffers above 5000' elevation for Yosemite toad and Sierra Nevada yellow legged frog would be 500' (600' total distance from stream or meadow) rather than 125' total under alternative 2. Invasive weed and DFPZ treatments with glyphosate would be the same as in alternative 2; and Borax treatments would remain the same as well.

Cumulative Effects

Cumulative effects are the same as for alternative 2.

3.8. Management Indicator Species (MIS)

The information presented in this section and in subsequent sections is summarized from the French Recovery and Reforestation Management Indicator Species Report (Otto and Wilkens, 2015) as well as the French Project Supplemental Black-backed woodpecker report (Otto 2015), which are hereby incorporated by reference.

3.8.1. Background and Affected Environment

A Management Indicator Species (MIS) Report was completed for this Project which documents the impacts of the proposed project on the habitat of the Management Indicator Species (MIS) identified in the SNF LRMP (USDA 1992) as amended by the Sierra Nevada Forests Management Indicator Species Amendment (SNF MIS

Amendment) Record of Decision (USDA Forest Service 2007). MIS habitats analyzed in the report include: aquatic macro invertebrates, fox sparrow, mule deer, yellow warbler, pacific chorus frog, mountain quail, sooty grouse, California spotted owl, American marten, northern flying squirrel, hairy woodpecker, and black-backed woodpecker. The analysis determined that the direct, indirect, and cumulative effects of the proposed project would not alter the existing trend in the MIS habitat, nor would it lead to a change in distribution of any MIS species throughout the Sierra Nevada bioregion (Otto and Wilkens 2015). The MIS report is hereby incorporated by reference. Detailed analysis is presented below for select MIS (Black-backed woodpecker and mule deer) to address concerns brought up during public scoping.

Black-backed Woodpecker

Background

The SNF manages the black-backed woodpecker (BBWO) as a Management Indicator Species for the ecosystem component of snags in burned forest habitat per the SNF LRMP (Forest Service 1992) as amended by the SNF MIS Amendment (Forest Service 2007). Per our current direction, project-level effects on MIS habitat are analyzed and disclosed as part of environmental analysis under the NEPA. This involves examining the impacts of the proposed project alternatives on MIS habitat by discussing how direct, indirect, and cumulative effects could change the habitat in the analysis area. These project-level impacts to habitat are then related to broader scale (bioregional) population and/or habitat trends. The direct, indirect and cumulative effects to suitable BBWO habitat are summarized from the French Project Management Indicator Species Report (Otto and Wilkens 2015). The direct, indirect, and cumulative effects to individual BBWOs are summarized from the Supplemental black-backed woodpecker assessment for the French Recovery and Reforestation Project (Otto 2015).

3.8.1.1. Indicators

The effects of the alternatives were evaluated using the indicators below. Although thresholds for these indicators have not been established, they provide general measures by which the effects of the alternatives may be compared.

Indicator 1: Acres of Suitable Black-backed Woodpecker Habitat

Acres of suitable habitat for the BBWO can be used to measure effects of the alternatives on nesting and foraging habitat availability. The acres of suitable habitat can be measured within the Project area and the Sierra Nevada bioregion.

Indicator 2: Snag Retention

The amount of large snags (greater than 15 inches dbh) that would be retained across the French Project area can be used to measure the effects of the alternatives on the availability of snags which may be used for nesting and foraging.

Indicator 3: Black-backed Woodpecker Territories and Disturbance to Individuals

Home range size estimates based on average snag basal area can be used to measure the effects of the alternatives. Additionally, the extent of disturbance to individual BBWOs (behavior on nesting birds, fledging, etc.) can be used to measure effects of the alternatives.

Analysis Methodology

All vegetation information is displayed using the CWHR vegetation codes (known as seral stage codes) and serve as the baseline acres for the analysis. Other sources of information used in the vegetation assessment were

aerial photos, burn severity maps, data generated from common stand exam plots and field reconnaissance. See Table 22 & 23 from Vegetation Section

Affected Environment

BBWOs are known to specialize on burned forest, but they also use unburned green forest as well as beetle-affected forest habitats. Since the Project proposes to remove fire-affected trees within the French Fire, we restricted this detailed analysis to burned forest, with suitable habitat defined as >50% conifer mortality. We only considered the following CWHR forest types: Douglas-Fir, Jeffrey Pine, Lodgepole Pine, Montane Hardwood-Conifer, Ponderosa Pine, Red Fir, Subalpine Conifer, Sierran Mixed Conifer, and White Fir in CWHR size classes greater or equal to 3 (size class 3 corresponds to 6-11 inch dbh) and where the CWHR tree canopy was moderate or dense (Table 30). These criteria correspond to the habitat preferences of BBWOs as outlined in the Conservation Strategy:

"Researchers working in different forest types have defined tree size classes in various ways, but as a general guideline, large snags indicative of preferred foraging habitat roughly correspond to California Wildlife Habitat Relationships (CWHR; Mayer and Laudenslayer 1988) size class 5 (dbh >24") and medium- and small-diameter snags typical of nesting habitat roughly correspond to CWHR size class 4 (dbh = 11-24") or occasionally 3 (dbh = 6-11")" (Bond et al. 2012, p. 9).

Table 29. CWHR Habitat Types Selected for Analysis.

Abbreviation	CWHR Habitats	CWHR Specific High and Moderate Capability Size, Canopy Cover, and Substrate Classes	Conifer Mortality
DFR	Douglas-Fir	3M, 3D, 4M, 4D, 5M, 5D, 6	≥50%
JPN	Jeffrey Pine	3M, 3D, 4M, 4D, 5M, 5D, 6	≥50%
LPN	Lodgepole Pine	3M, 3D, 4M, 4D, 5M, 5D, 6	≥50%
MHC	Montane Hardwood-Conifer	3M, 3D, 4M, 4D, 5M, 5D, 6	≥50%
PPN	Ponderosa Pine	3M, 3D, 4M, 4D, 5M, 5D, 6	≥50%
RFR	Red Fir	3M, 3D, 4M, 4D, 5M, 5D, 6	≥50%
SCN	Subalpine Conifer	3M, 3D, 4M, 4D, 5M, 5D, 6	≥50%
SMC	Sierra Mixed Conifer	3M, 3D, 4M, 4D, 5M, 5D, 6	≥50%
WFR	White Fir	3M, 3D, 4M, 4D, 5M, 5D, 6	≥50%

3.8.2. Environmental Consequences

Based on GIS analysis of conifer mortality areas and CWHR habitat types within the French Project area, there are a total of 3,616 acres of suitable BBWO habitat within the Project (Table 28). Of these acres, 1,673 acres, or 46% are not proposed for any type of treatment. A total of 1,943 acres or 54% are proposed for some type of treatment under Alternatives 2 and 3, including road hazard removal, powerline fuels cleanup, and salvage removal of trees.

In the Conservation Strategy for BBWO, Bond et al. (2012) assert that BBWOs are not correlated with any particular tree species or forest type apart from burned and (less commonly) unburned coniferous forests with high densities of larger trees. Based on this information, CWHR conifer habitat data for the Project area was grouped based on CWHR size and canopy closure classes (Table 31).

Table 30. Acres of BBWO Habitat (≥50% Mortality) Proposed for Treatment and Retention (Alternatives 2 and 3) grouped by CWHR size and canopy closure classes*

CWHR Size and Canopy Closure	Total BBWO Habitat	No Treatment	Roadside Hazard**	Proposed Salvage – Fire Affected	Proposed Salvage Second-entry Fire Weakened Insect Killed	DFPZ/ Powerline corridor/ plantation treatment	% Habitat Retained by CWHR Size and Canopy Closure
3MD	224	85	12	53	9	65	38%
4MD	3209	1507	231	1140	248	82	47%
5MD	184	81	14	80	11	1	44%
Grand Totals	**3617**	**1673**	**257**	**1273**	**268**	**148**	**46%**

*Acres may differ slightly due to rounding **Hazards tree acreage is based on a 150 foot buffer on each side of the road in GIS. Actual hazard trees will be identified and assessed in the field. >95% of the hazard trees identified are within 150 feet of the road. Trees determined to present a hazard will be removed for firefighter and public safety. Hazard trees are located sporadically throughout the buffer, so the acre figure shown above is not a continuous strip of trees being removed.

There are a total of 3,617 acres of >50% mortality 3MD,4MD and 5MD habitat present within the project, of which a total of 1,946 acres are proposed for treatment and 1,673 acres are proposed for retention. Therefore, nearly half (46%) of the highest quality BBWO habitat (>50% mortality CWHR 3MD, 4MD and 5MD) within the project area is proposed for retention. This is in line with the first recommendation made in the BBWO Conservation Strategy, which recommends retaining large patches of burned forest, particularly areas with the highest densities of the largest snags (Bond et al 2012).

The distribution of BBWO habitat across the Project area is displayed in Figure 22. Areas of habitat retention are displayed by the lumped CWHR size and canopy closure classes discussed above. All proposed treatments for Alternatives 2 and 3 that overlap suitable BBWO habitat are displayed in black. Treatments include roadside hazard removal, first and second entry salvage, plantation treatment, DFPZ and powerline treatments. The figure displays the distribution of retention habitat throughout the Project boundary.

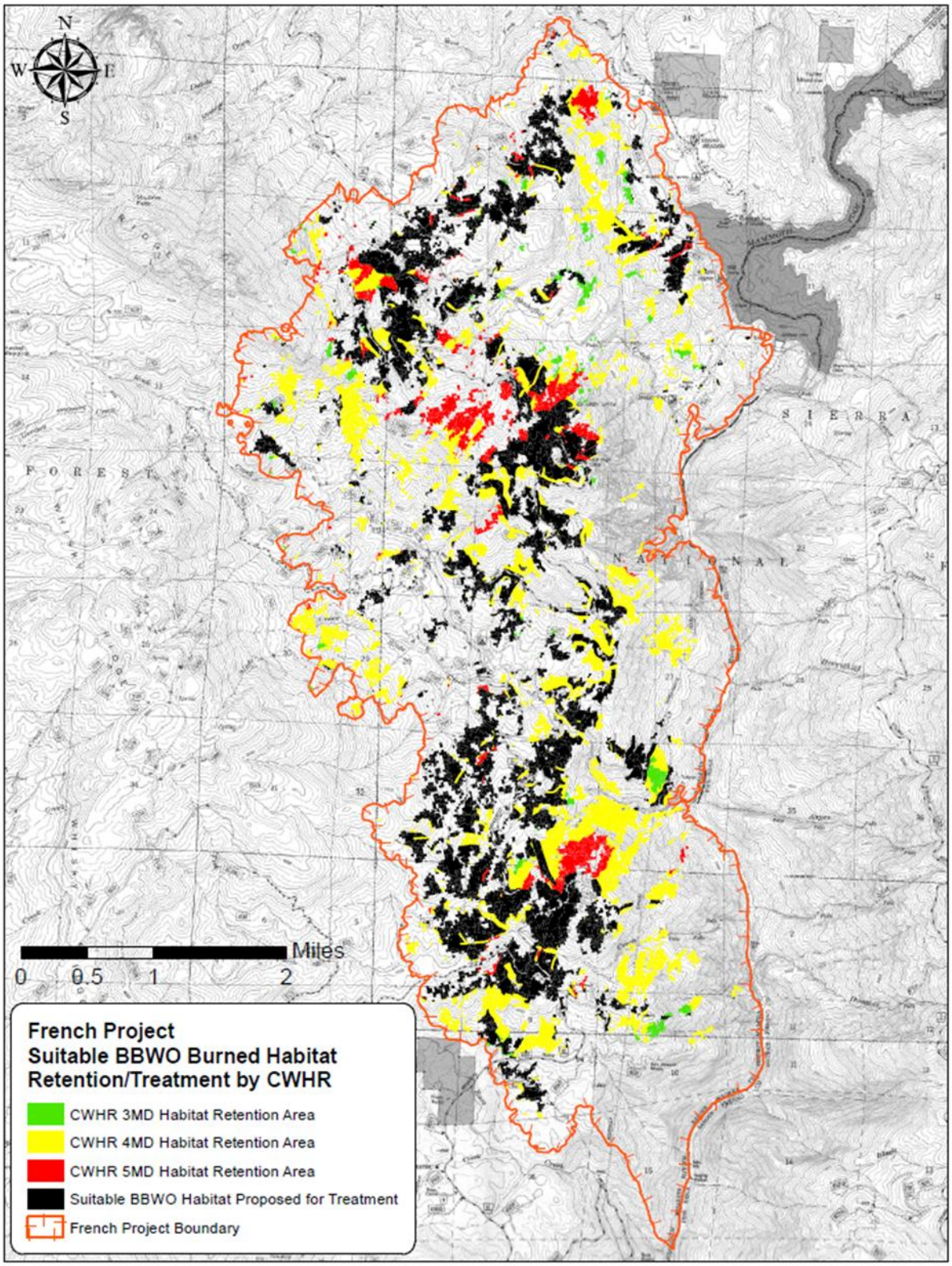


Figure 22. Suitable BBWO burned Habitat Retention and Proposed Action Treatment Areas by CWHR size and density cover.

Home Range Estimates and Territories

The Institute for Bird Populations (IBP) explored the relationship between BBWO home-range size and snag basal area and used this relationship to model BBWO home range occupancy probability in the Rim fire area of the Stanislaus National Forest (Tingley et al. 2014). Upon request, IBP performed a similar analysis for the French Fire area. The model provides relative expected pair density values assuming occupancy on the landscape. Based on the IBP model, the entire French Fire could provide habitat for up to 15.6 woodpecker pairs.

Project Landscape Snag Assessment

A landscape scale assessment of large snags (>15” dbh) across the Project was conducted to determine the numbers of post treatment snags available for wildlife. This assessment was conducted for the conifer-dominated vegetation types preferred by BBWO (MHC, PPN, and SMC) and used the 255 vegetation plots collected within those CWHR types in the project area. Current conditions indicate that within the Project area, there is a weighted average of 26.3 large (>15”dbh) snags/acre across the landscape within BBWO vegetation types. Within snag retention areas where no treatments would occur, there are an average of 28.6 large snags/acre in the high conifer mortality areas, and an average of 23.5 snags/acre in the low conifer mortality areas. This equates to a total of 88,525 snags across 3,371 acres of the Project area delineated for snag retention in large contiguous patches up to 250+ acres in size.

Spatial and Temporal Context for Effects Analysis

The core analysis area is defined as the French Fire boundary because the Project would primarily treat and modify burned areas only. The regional analysis area is defined as the range of the BBWO in California which is primarily in the Sierra Nevada. The temporal scale for the analysis includes recent projects within the previous 8 years which are now part of the current condition.

3.8.3. Alternative 1 (No Action)

Direct, Indirect and Cumulative Effects

Indicators 1 –3: Acres of Suitable BBWO Habitat; Snag Retention; and Territories and Disturbance to Individuals

Under the No Action alternative, there would be no treatments occurring, therefore, there would be no effects to the BBWO and its habitat or home ranges. There would be no direct or indirect effects on snags in burned forest habitat because no activities would occur that would impact the existing habitat conditions. It is anticipated that Alternative 1, in combination with past, present and reasonably foreseeable future actions, would not have a cumulative effect to the snags in burned forest habitat within the analysis area. Under Alternative 1, there would likely be a short term population increase of BBWO resulting from the suitable habitat created by the wildfire. However if acres of conifer forest that burned at high severity are not treated and reforested, some areas could convert to chaparral, reducing the future amount of conifer forest in the Project area.

3.8.4. Alternative 2 (Proposed Action)

Direct and Indirect Effects

Direct and indirect effects on the BBWO may result from the modification or loss of foraging and nesting habitat. Proposed treatments may cause behavioral disturbance to BBWO from logging or other associated activities which could inhibit nesting or reduce nesting success.

Indicator 1: Acres of Suitable BBWO Habitat

Although some loss of BBWO nesting and foraging habitat is projected to occur under Alternative 2, due to the retention of large contiguous blocks of untreated habitat and delineation of snag retention areas, approximately half (46%) of the suitable BBWO habitat would be retained across the Project area. Additionally, based on the IBP BBWO model, the majority (56%) of projected BBWO territories would be retained within the Project area.

High severity burned habitat that is retained would provide large patches of suitable habitat for BBWO throughout the Project area. Further, snag retention areas that are delineated within treatment units would continue to provide foraging and nesting substrates for BBWO. Snag retention within streamside management zones (SMZs) would ameliorate potential adverse Project effects on habitat loss and fragmentation by providing corridors throughout the Project area, connecting areas that provide potentially suitable BBWO habitat. Thus, BBWO habitat, suitable for nesting and foraging, would remain present throughout the Project area after Project implementation and under any of the action alternatives. Although the retention and continued availability of suitable BBWO habitat throughout the Project area would not eliminate negative impacts of the alternative 2 to BBWOs, it would mediate these effects to some extent.

Indicator 2: Snag Retention

Current conditions indicate that within the Project area, there is a weighted average of 26.3 large (>15”dbh) snags/acre across the landscape. Within snag retention areas where no treatments would occur, there are an average of 28.6 large snags/acre remaining in the high conifer mortality areas, and an average of 23.5 snags/acre remaining in the low conifer mortality areas. Within the areas proposed for treatment, a total of 22,456 individual snags and a weighted average of 4.0 large snags/acre would remain across the conifer-dominated treatment areas (4,021 acres).

A total of 110,980 individual large snags would remain across the 7,392 acres of conifer dominated vegetation types within the Project area. This equates to a weighted average of 15 large snags/acre remaining post implementation across the French Fire landscape. It is important to note that not all snags would be evenly distributed across the landscape. For instance, very high levels of large snags would remain in the high/moderate conifer mortality areas designated for snag retention. Within these areas, an average of 26.3 large snags/acre would remain across 3,371 acres, equating to 88,525 individual large snags retained in large contiguous patches up to 250 acres in size.

Indicator 3: BBWO Territories and Disturbance to Individuals

The IBP explored the relationship between BBWO home-range size and snag basal area and used this relationship to model BBWO home range occupancy for the French Fire area. The model provides relative expected pair density values assuming occupancy on the landscape. Based on the IBP model, the entire French Fire could provide habitat for up to 15.6 woodpecker pairs. Proposed treatments (Alternative 2) would remove habitat for 6.8 pairs. By treatment type: roadside hazard treatments are expected to remove habitat for 1.2 pairs, first and secondary entry salvage treatments are expected to remove habitat for 4.8 pairs, and plantation/powerline/DFPZ treatments are expected to remove habitat for 0.8 pairs. Based on the IBP analysis, habitat would remain for 8.8 BBWO pairs (56% retained) under Alternative 2.

Harvest activities in 2015 could begin in August and, depending on weather conditions, could continue through November or December 2015. Operations during this time period would be outside of the nesting season for BBWO, therefore no direct effects would be expected. Birds that may be foraging in areas of operation would move to non-disturbed areas of the fire. Harvest activities in 2016 are anticipated to begin as early as June 30, which is the later portion of the breeding season for many land birds. Siegel et al. (2013) observed a total of 21

BBWO nests across three recent fire areas in California. Estimated dates for the initiation of incubation ranged from April 28 to June 26, while estimated fledgling dates ranged from June 4 to July 25 (Siegel et al. 2013).

According to these data, the majority of BBWO nests (14 of 21 or 66%) successfully fledged young prior to June 30. Five nest attempts failed partway through the nestling stage due to predation or unknown factors. Of these, two nests were projected to fledge young prior to June 30, indicating that 16 of 21 or 76% of all monitored BBWO nests would have fledged young prior to June 30. All action alternatives for the Project include a Limited Operating Period (LOP) for Pacific fishers, prohibiting mechanical operations from March 1 through June 30 within the 3,500 – 6,500 foot elevational range. Based on this data, harvest activities throughout most of the Project would not occur until after June 30, which would likely represent the time period after the majority of BBWO nests have fledged. Some individual BBWO may be harmed by operations if there are active nests at the later part of the fledging period.

Since the majority of BBWO territories would be retained, and the number of snags available at the landscape scale would not be greatly diminished, it is unlikely that BBWO would be substantially impacted by the proposed activities.

3.8.5 Alternative 3 (No Herbicide)

Direct and Indirect Effects

Indicators 1 –3: Acres of Suitable BBWO Habitat; Snag Retention; and Territories and Disturbance to Individuals

Alternative 3 will consist of the same treatments as defined by Alternative 2; however, site preparation under Alternative 2 consists of a combination of hand, mechanical, and chemical (herbicide) methods, while site preparation methods for Alternative 3 do not include the use of herbicides. Planting strategies will occur as described in the proposed action and release treatments are limited to hand and mechanical methods. Hand and mechanical methods would be used to meet the objective of retaining less than 20% brush cover on moderate and high productivity sites and less than 15% on low productivity sites. There would not be an effect to BBWO if herbicides are used in this manner because there is little chance that they would ingest the chemicals. Herbicides would be applied to noxious weeds and shrubs, while BBWO forage exclusively on trees and (very infrequently) on downed logs. Alternative 3 would also have an LOP for fisher prohibiting mechanical activities from March 1 through June 30 within the 3,500-6,500’ elevation band, so it is likely that the majority of BBWO nests will have fledged prior to treatments. Therefore, the direct and indirect effects are similar for Alternatives 2 and 3.

3.8.6. Alternative 4 (Hazard Tree and Plantation Salvage Only)

Direct and Indirect Effects

Indicators 1 –3: Acres of Suitable BBWO Habitat; Snag Retention; and Territories and Disturbance to Individuals

Alternative 4 proposes to conduct roadside hazard tree removal and removal of fire-killed trees within existing plantation areas only. This alternative would treat less BBWO habitat (22% proposed for treatment) across the project area, with 78% of the habitat retained. Based on the IBP BBWO home range model, Alternative 4 would retain habitat for 12.3 pairs.

This would have short-term benefits for BBWO who may utilize the habitat 1-8 years post fire, after which beetle larvae and BBWO use of the habitat decreases dramatically (Bond et al 2012). A trade-off of not conducting salvage logging and reforestation in the areas identified for first entry salvage (under Alternatives 2, 3 and 5) is that some large patches of coniferous forest that burned at high severity may not return to coniferous

forest in the foreseeable future and would likely convert to chaparral/shrubland leading to a potential decrease in the amount of conifer forested habitat over the long term. Alternative 4 would retain 21.8 snags/acre across the landscape since treatments would only occur along roadsides and within existing plantations. This is 6.8 more snags/acre than Alternative 2.

It is expected that Alternative 4 would result in less behavioral disturbance to nesting BBWO from logging or other associated activities within or adjacent to occupied habitat which could inhibit nesting or reduce nesting success. Alternative 4 would also have an LOP for fisher prohibiting mechanical activities from March 1 through June 30 within the 3,500-6,500' elevation band, so it is likely that the majority of BBWO nests will have fledged prior to treatments that may occur in 2016.

3.8.7. Alternative 5 (No Secondary Entry)

Direct and Indirect Effects

Indicators 1 –3: Acres of Suitable BBWO Habitat; Snag Retention; and Territories and Disturbance to Individuals

Alternative 5 is similar to alternative 2 except there would be no secondary salvage proposed for areas where insect/drought are expected to kill fire-weakened trees. Slightly fewer acres of BBWO habitat would be proposed for treatment compared to Alternative 2, therefore more snags would be retained. Alternative 5 would treat 1,716 acres (48%) of the suitable BBWO habitat, with 52% retained. Based on the IBP model, Alternative 5 would retain slightly more habitat than the proposed action, with habitat for 9.8 pairs remaining. Alternative 5 would retain 16.8 snags/acre since treatments would not occur in the areas proposed for secondary salvage under the proposed action. This is 1.8 snags/acre more than the alternative 2.

It is expected that Alternative 5 would result in slightly less behavioral disturbance to nesting BBWO when compared to Alternative 2. Behavioral disturbance from logging or other associated activities within or adjacent to occupied habitat could inhibit nesting or reduce nesting success. Alternative 5 would also have an LOP for fisher prohibiting mechanical activities from March 1 through June 30 within the 3,500-6,500' elevation band, so it is likely that the majority of BBWO nests will have fledged prior to treatments that may occur in 2016.

Cumulative Effects

Appendix E describes the past, present, and reasonably foreseeable future actions affecting the Project area. The spatial scale is defined as the Project boundary and the bioregional scale. The temporal scale includes recent projects within the past 8 years which are now part of the current condition, as well as present and reasonably foreseeable projects. As a result of the French Fire, many trees along NFS roads were damaged and could fall into the roadway, posing a safety and access hazard to area residents and landowners, Forest Service personnel and contractors, special use permit holders, and the visiting public. Bass Lake Ranger District is currently implementing the Mile High Roadside Hazard Tree Removal Project on approximately 250 acres along forest road 4S81. This road is a National scenic byway which traverses through the center of the French Fire. The majority of hazard trees proposed for removal occur in high severity burned areas; however, hazard trees within mixed severity burned areas will also be included to ensure the safety of road users in all those areas where burned trees pose a genuine risk of falling into the roadway. These activities would have an effect on the number of burned snags remaining on up to 250 acres across all burn severities in the analysis area.

Most of the recreation use within the wildlife analysis areas consists of dispersed camping, hiking, horseback riding, hunting, mining, mountain biking, OHV use, pleasure driving, and wildlife watching. The use is expected to continue at the current rate. These activities could have a minimal effect on numbers of snags in burned forest habitat if the snags pose a safety hazard within a designated campground.

There appears to be well-distributed high-value habitat from other smaller fires that have occurred over the past 8 years on the SNF. BBWO have been detected in the Oliver fire on the Bass Lake Ranger District, and the Tehipite fire on the High Sierra Ranger District. No salvage operations were conducted in these fire areas. Additionally, numerous smaller wildfires have burned in a mosaic across the SNF within the past several years. These fires are often in remote wilderness settings, and have not been monitored for Black-backed Woodpecker occupancy, but include areas of highly suitable habitat. These fires include the Bear fire of 2012 (718 acres), the Buckhorn fire of 2010 (471 acres), the Star fire of 2008 (235 acres), the Carstens fire of 2013 (1,708 acres) and the Courtney fire of 2014 (320 acres).

These fires continue to provide well-distributed habitat for the Black-backed Woodpecker across the SNF. Additionally, the Aspen fire of 2013 burned 22,350 acres directly across the San Joaquin River canyon from areas the French Fire burned in 2014. Some hazard and salvage logging has been conducted within the Aspen fire area, and treatments are ongoing; however the majority of the fire area is being left untreated (75%) and the majority of high quality BBWO habitat (57%) is being retained (Otto 2014). To date, IBP has not conducted monitoring surveys for BBWO in the Aspen fire area.

There are also thousands of acres of beetle infested stands across the SNF due to increased insect activity, which is exacerbated by the current drought conditions. BBWO are known to utilize beetle-killed forest stands as high quality habitat (Goggans et al, 1989). BBWO are also known to utilize green forest habitat, particularly lodgepole pine (Purcell 2010). There are approximately 33,000 acres of lodgepole pine habitat across the SNF. Despite some habitat removal within the French Fire, BBWO habitat of all types would continue to be well distributed throughout the SNF.

As the majority of the suitable BBWO habitat across SNF is not proposed for treatment, and nearly half of the suitable habitat within the Project area (46%) would be retained, the existing trend in the habitat for this MIS species would not be altered. Overall there would be an increase in suitable habitat over pre-fire conditions and local populations should remain relatively stable given the retention of such a large portion of potentially suitable habitat post-project.

A regional analysis was conducted for BBWO which analyzes treatment of suitable burned BBWO habitat across the range of the BBWO in California, including the 10 Sierra Nevada forests from 2006-2013. These analyses are also in the process of being updated to include data from the fires which occurred in 2014. This analysis shows that the majority of suitable burned BBWO habitat is being retained throughout the bioregion both on Forest System lands (79% retained) and across all lands (69% retained). Based on this information, and taking into account all past, present, and reasonably foreseeable actions, it appears the French project would not alter the existing trend in the ecosystem component, nor would it lead to a change in the distribution of BBWO across their range in California.

Mule Deer

Analysis Methodology

The mule deer was selected as the MIS for oak-associated hardwood and hardwood/conifer in the Sierra Nevada, comprised of montane hardwood (MHW) and montane hardwood-conifer (MHC) as defined by the CWHR (CDFG 2005). Mule deer range and habitat includes coniferous forest, foothill woodland, chaparral, grassland, agricultural fields, and suburban environments (CDFG 2005). Many mule deer migrate seasonally between higher elevation summer range and low elevation winter range (Ibid). On the west slope of the Sierra Nevada, oak-associated hardwood and hardwood/conifer areas are an important winter habitat (CDFG 1998).

Indicators for the Analysis:

(1) Acres of oak-associated hardwood and hardwood/conifer habitat [CWHR montane hardwood (MHW), montane hardwood-conifer (MHC)].

(2) Acres with changes in hardwood canopy cover.

(3) Acres with changes in CWHR size class of hardwoods.

Affected Environment

There are 7,580 acres (55%) of MHW and MHC within the French Fire perimeter. There are a total of 2,808 acres (37%) recommended for treatment under alternative 2in all mortality categories.

3.8.8. Environmental Consequences

Potential direct effects include removal of fire-killed or hazard trees and subsequent reforestation. Tree removal would not change CWHR habitat types within treated stands because the trees proposed for removal are dead (killed by fire) and do not contribute to canopy closure. Alternative 2 includes reforestation of conifers to promote the reestablishment and development of a mature, closed canopy, coniferous forest. Alternative 2 proposes to reforest salvaged acres (up to 3,000 acres) with a mix of ponderosa, sugar pine, and cedar seedlings. Reforestation would not be proposed in areas that were predominantly hardwood (MHW) or chaparral (MCH, MCP) prior to the fire. This would ensure habitat heterogeneity throughout the project area as hardwood and chaparral habitats naturally regenerate.

3.8.9. Alternative 1 (No Action)

Direct, Indirect, and Cumulative Effects to Habitat

There would be no direct or indirect effects on short term oak-associated hardwood & hardwood/conifer habitat, acres with changes in hardwood canopy cover or acres with changes in CWHR size class of hardwoods because no activities would occur that would impact the existing habitat conditions; therefore, since there are no effects of the alternative there would be no additional cumulative effects as a result of selecting this alternative. As a result oak-associated hardwood & hardwood/conifer habitat conditions would be maintained.

3.8.10. Alternative 2 (Proposed Action)

Direct and Indirect Effects

Under the proposed action the majority of the acres of oak-associated hardwood and hardwood/conifer habitat would not be treated. Fifty-five percent of the analysis area is oak-associated hardwood and hardwood/conifer habitat (7,580 acres) and approximately 37% (2,808 acres) is proposed for treatment including: 1,238 acres within the roadside hazard treatment areas, 136 acres in plantations, 1,309 acres in first and second entry salvage, and 125 acres within the powerline corridor and DFPZ areas. The majority of hardwood habitat (63%) would not be treated and thus would naturally return to hardwood as it was pre fire. No oaks would be removed by Project activities unless they are a hazard to the roadside. No conifer planting would occur in montane hardwood (MHW) stands allowing these areas to regenerate naturally to a mix of oak with a chaparral/bear clover understory. Conifer planting may occur in montane hardwood-conifer areas (MHC) however conifers would not be planted within 20 feet of existing oak crowns. Due to these Project design criteria, this alternative would have minimal effects on the regeneration of oak canopy cover and size class. Oak stumps may re-sprout following fire, giving oaks an advantage over conifers in post-fire re-establishment. If oak seedlings are not heavily browsed, re-sprouting oaks should reach 5-6 ft. in height in 3-4 years, and may reach 20-25 ft. high in 20 years (Smith 2015).

3.8.11. Alternative 3 (No Herbicide)

Direct and Indirect Effects

The direct and indirect effects to oak-associated hardwood and hardwood/conifer habitat are similar as described under Alternative 2. Under this alternative no herbicide (glyphosate) would be used to treat noxious weeds or reduce competing vegetation (e.g. bear clover) from conifer plantations. This would lead to substantially lower success of reforestation, which could lead to an increase in chaparral/shrubland habitat across the Project area and potentially a decrease in the amount of hardwood/conifer habitat. Hardwoods in MHW stands would out-compete bear clover but the conifers within MHC habitat would not be able to compete with the bear clover, potentially leading to type conversion of MHC to MHW.

3.8.12. Alternative 4 (Hazard Tree and Plantation Only)

Direct and Indirect Effects

Under this alternative the majority of the acres of oak-associated hardwood and hardwood/conifer habitat would not be treated. Fifty-five percent of the analysis area is oak-associated hardwood and hardwood/conifer habitat (7,580 acres) and approximately 27% (2,034 acres) is proposed for treatment including: 1,751 acres within the roadside hazard treatment areas, 120 acres in plantations, and 163 acres within the powerline corridor and DFPZ areas. The majority of hardwood habitat (73%) is not being treated and thus would naturally return to hardwood as it was pre fire. The acres that are receiving treatment would also return to hardwood forest naturally, and the conifer component of the MHC would be planted to maintain this habitat type. Due to the project design criteria discussed in alternative 2, this alternative would have minimal effects on the regeneration of oak canopy cover and size class.

3.8.13. Alternative 5 (No Secondary Entry)

Direct and Indirect Effects

Under this alternative the majority of the acres of oak-associated hardwood and hardwood/conifer habitat would not be treated. Fifty-five percent of the analysis area is oak-associated hardwood and hardwood/conifer habitat (7,580 acres) and approximately 34% (2,541 acres) is proposed for treatment including: 1,441 acres within the roadside hazard treatment areas, 145 acres in plantations, 822 acres in first entry salvage, and 134 acres within the powerline corridor and DFPZ areas. The majority of hardwood habitat (66%) would not be treated and thus would naturally return to hardwood as it was pre fire. The acres that are receiving treatment would also return to hardwood forest naturally, and the conifer component of the MHC would be planted to maintain this habitat type. Due to the project design criteria discussed in alternative 2, this alternative would have minimal effects on the regeneration of oak canopy cover and size class.

Cumulative Effects

Appendix F describes the past, present, and reasonably foreseeable future actions affecting this habitat. The existing condition reflects the changes of all activities that have occurred in the past. On-going and future proposed activities will be discussed further in the cumulative effects analysis. The analysis of cumulative effects of the alternatives evaluates the impact on MIS habitat from the existing condition within the analysis area.

As a result of the French Fire, many trees along NFS roads were damaged and could fall into the roadway, posing a safety and access hazard to area residents and landowners, Forest Service personnel and contractors, special use permit holders, and the visiting public. Bass Lake Ranger District is currently implementing the Mile High Roadside Hazard Tree Removal Project on approximately 250 acres along forest road 4S81. This

road is a National scenic byway which traverses through the center of the French Fire. The majority of hazard trees proposed for removal occur in high severity burned areas; however, hazard trees within mixed severity burned areas would also be included to ensure the safety of road users in all those areas where burned trees pose a genuine risk of falling into the roadway. These activities would have little to no effect on hardwood habitat in the analysis area.

Most of the recreation use within the wildlife analysis areas consists of dispersed camping, hiking, horseback riding, hunting, mining, mountain biking, OHV use, pleasure driving, and wildlife watching. The use is expected to continue at the current rate. These activities would have no effect on hardwood habitat in the analysis area.

Cumulative Effects Conclusion: It is anticipated that implementation of the action alternatives, in combination with present and reasonably foreseeable future actions may slightly decrease or maintain the amount of oak-associated hardwood and hardwood/conifer habitat through reforestation within the analysis area. These changes would not alter the existing trend in the hardwood habitat.

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Mule Deer Trend: Of the total oak-associated hardwood and hardwood/conifer habitat within the Project area, over half of the total acres burned within the high mortality category. This is a major change in canopy cover of oak-associated hardwood and hardwood/conifer habitat in the Project area, however the change in canopy cover across 4,174 acres out of 808,006 acres (0.5%) at the bioregional scale would not alter the existing trend in the habitat, nor would it lead to a change in the distribution of mule deer across the Sierra Nevada bioregion.

3.9. Terrestrial Wildlife

3.9.1. Background and Affected Environment

One of the focuses of the terrestrial wildlife analysis is to address the effectiveness of the alternatives in meeting the purpose and need to protect sensitive terrestrial wildlife species and to protect and enhance their potential and suitable habitat within the Project area. The analysis also addresses concerns and recommendations raised during scoping related to providing greater emphasis on the protection of FSS species, California spotted owl, Northern goshawk, pallid bat, fringed myotis, and proposed species Pacific fisher as well as habitat for these species. A BE/BA (Otto 2015) has been completed for this Project, and is hereby incorporated by reference.

3.9.1.1. Indicators

Although thresholds for these indicators have not been established, they provide general measures by which the effects of the Project alternatives may be compared. When assessing the effects of treatments on wildlife species it is important to remember treatments would not occur on some suitable acres. The number varies due to the different habitat types used by the particular species. The effects of the alternatives were evaluated using the indicators below.

Indicator 1: Acres of suitable habitat modified, lost or fragmented

Indicator 2: Habitat components modified, lost or fragmented

Analysis Methodology

The following assumptions apply specifically to the analysis:

1. All standards and guidelines, standard operating procedures (SOPs), Project specific design features and mitigations will be fully adhered to and implemented.
2. All activities proposed would be completed within approximately 5 to 7 years.

3. All hardwoods and wildlife inhabited trees (nest trees, roosts, etc.) would be retained unless they pose a safety hazard.
4. Plot data shows that spotted owl, goshawk and fisher habitat that burned at moderate to high severity (>50% basal area mortality) experienced severe canopy cover reductions. Pre-fire canopy cover ranged from 45-50% and now measures 3-7%. Due to these severe changes in habitat condition, spotted owl and goshawk nesting habitat and fisher denning habitat that burned in the >50% BA mortality range is not considered suitable nesting or denning habitat for the analysis. This habitat may still be utilized as foraging habitat and is considered foraging habitat for the analysis.

The Project was reviewed on the ground and using aerial photographs, vegetation layer spatial datasets, species specific spatial datasets and known information to help determine the potential presence of FSS species. Observations of FSS species are documented and georeferenced while conducting surveys for other species and projects. Species nest sites and locations are then incorporated into forest-level spatial datasets. For the analysis of effects, changes to suitable habitat were determined by using a spatial dataset of the vegetation layer combined with treatment type (e.g., Roadside Hazard Tree). All vegetation information is displayed using the CWHR vegetation codes and serves as the baseline acres for analyses.

The analysis used the following habitat data: Vegetation burn severity data (RAVG), SNF corporate GIS layer (existing vegetation) with aerial photo adjustments, as well as plot data (Common Stand Exam) taken in the field several months after the French Fire. The stand exam crew took 337 plots within the fire area. The results show that there is little difference between moderate (50-75% BA mortality) and high severity (>75% BA mortality) areas based upon loss of basal area; therefore, the two categories are grouped in the analysis (>50% BA mortality). The canopy cover will be shown pre and post fire by percent.

Herbicide was not used as an indicator because the risk is negligible to terrestrial wildlife when glyphosate is applied at the recommended rate. The toxicity is extremely low because it is highly water soluble, therefore does not bioaccumulate, and because the mode of action is by inhibiting the formation of the amino acid phenylalanine. This is one of the essential amino acids, which cannot be synthesized by animals, therefore the mode of action is affecting a process exclusive to plants. More information can be found in the Terrestrial Wildlife Reports in the Project Record.

Affected Environment

The following two sections (snag component and log component) are included here because they are an important consideration when analyzing these species. Large snags and large downed logs are an important component of wildlife habitat; especially for species that are typically associated with late-successional habitats (California spotted owl, Northern goshawk, and fisher).

Snag Component

In forest ecology, a snag refers to a standing, dead or dying tree, often missing a top or part of the branches. Snags create nesting, foraging and roosting habitat for a variety of wildlife species (Russell et al 2006). Approximately 1,200 wildlife species (birds, mammals, amphibians and reptiles) in the United States rely on dead, dying or hollow trees for den, nests, roost areas and feeding sites (Animal Inn, U.S. Forest Service program).

The SNF LRMP as amended by the 2004 SNFPA ROD states for snag retention in Standard and Guideline 11 –

- westside mixed conifer and ponderosa pine types – four of the largest snags per acre;
- red fir forest type – six of the largest snags per acre; and
- the westside hardwood ecosystems – four of the largest snags (hardwood or conifer per acre).

Snag Retention

The snag retention strategy for the Project is twofold:

1. **Snag Retention within Proposed Treatment Units**

Snags within proposed first and secondary treatment units would be identified for retention at an average of four snags per acre. All snags identified for retention would be ≥15" DBH, with the largest size-classes representing the highest priority for retention. Snag retention patches would be identified in riparian zones and on the edges of treatment units where possible to minimize the future hazard potential for reforestation crews planting trees in the treated areas. Snag retention patches within units range from several acres in size to smaller groups of four to ten snags. Snag retention patches should be co-located adjacent to mature green forest where possible to maximize their future use by old-forest associated species such as California spotted owl. Some retention snags would be randomly distributed throughout the stands to meet soil resource standards.

2. **Snag Retention outside of Proposed Treatment Areas**

During the Project development phase, managers identified large patches (up to 250 acres in size) of snag retention areas in conifer-dominated habitats throughout the Project area. These are areas where no snag-removal treatments would occur to provide suitable habitat.

3. **Management Criteria for Snag Retention**
   - Snags would be distributed at a minimum of four per acre averaged over each ten acres (i.e. a ten-acre unit needs 40 snags). They would be selected for longevity on the landscape for wildlife species.
   - Snags greater than 30 inches dbh are the top priority for retention. Retained snags below this diameter may be retained if they have 'defects' (unique branching such as large limbs, witches brooms, fork-tops, etc.; cavities catfaces, swollen boles, etc.). The largest trees with defects would be retained. If there are no trees with defects, then the largest trees in the units would be retained. At the minimum, all retained snags will be a minimum of 20 feet tall and at least 15 inches in dbh.
   - Snags should be clumped and distributed irregularly across the treatment units (S&G 11). An average minimum of four of the largest snags per acre will be retained for mixed conifer and ponderosa pine forests, and an average minimum of six of the largest snags per acre will be retained for red fir forests.
   - The treatments were designed to implement and sustain a generally continuous supply of snags and live decadent trees suitable for cavity nesting wildlife across a landscape. Snags larger than 15 inches dbh were used to meet this guideline.
   - Groups of snags would be retained around riparian areas, brush fields, and meadows to provide perches and cavities.

Projections for additional mortality within the Project area show that sufficient levels of snag recruitment would occur to meet standards and guidelines for retaining at an average of four snags per acre and 5 to 10 tons of downed logs per acre across the Project over the next 10 years.

Snags and cavities are abundant as a result of the French Fire, especially in the high/moderate mortality areas, but in these areas canopy closure is extremely low (3-7% post fire canopy cover) and nesting by mature forest associated species such as the California spotted owl would not be expected to take place. Low severity areas lost about 40% of existing basal area. The majority of the low mortality areas provide foraging habitat now. The moderate mortality areas lost 63-81% of basal area. Foraging may occur in small patches of high/moderate severity burn, but is expected to be much lower in the large patches of high/moderate severity where virtually no canopy cover or understory vegetation is now present.

The burned area that is not salvage logged would retain its existing snags. Additional snags would also be recruited over approximately the next five to ten years, because some trees that may have survived the immediate effects of the fire will eventually die from the combined stresses of the fire and subsequent insect attacks and drought stress. The landscape would retain a mosaic of areas with moderate to high densities of snags, consisting of a variety of sizes and decay classes.

Salvage treatments would retain an average of four snags per acre across the treated areas. Virtually no snags would remain in the inner 150' roadside hazard buffer, however snag retention zones delineated within first and

secondary entry units would retain additional snags to make up for this deficit along roadsides. A majority of the conifer and hardwood vegetation types throughout the project (6,709 acres or 56% of the Project area) would retain an average of 24.9 snags per acre because these acres are outside of proposed treatment areas. The table below shows the number of large snags (>15" dbh) per acre within conifer and hardwood dominated vegetation types. The information is displayed by proposed treatment: snag retention, proposed fire salvage (first and secondary entry), roadside hazard removals, DFPZ, and powerline. The table displays data for both Alternatives 2 and 3. Considering the current weighted average of snags across the French landscape is 24.9 snags/acre, and the projected weighted average for snags retained is 16.4 snags/acre, there would be a reduction of 8.5 snags/acre across the landscape. This does not appear to be a substantial reduction in snags across the landscape. Far more snags would be present compared to pre-fire conditions.

Log Component

Dead and down logs are important habitat components for many wildlife species. Similar to snags there are five decay classes. The following information is a general description of downed dead trees decay classes 1-5 from the CWD and Fine Woody Debris (FWD) in Forest Ecosystems from Oregon State University and the Northern Research Station for the Forest Service. Decay class 1: freshly fallen, intact logs with no rot, original color of wood; Class 2: sound log sapwood partly soft but can't be pulled apart by hand, many fine twigs are gone; Class 3: heartwood is still sound, sapwood can be pulled apart by hand or is missing, roots may be invading sapwood; Class 4: heartwood is rotten with piece unable to support owl weight, rotten portions of piece are soft, branch stubs can be pulled out and Class 5: There is no remaining structural integrity to the piece with a lack of shape as rot spreads out across ground, rotten texture is soft and can become dry powder when dry, usually branch stubs have usually rotten down (http://lterdev.fsl.orst.edu/lter/pubs/webdocs/reports/detritus/main_index.shtml).

Plot data on the average numbers of downed logs/acre in the French Fire area is displayed in Table 32. Dead and down log components would increase over time for each of the alternatives as snags that remain on the landscape fall and decay.

Table 31. Field Inventory Data Large Woody Debris (LWD) within French Fire boundary (Current conditions post-fire)

Average Number of Logs/acre by Diameter Class			
12-20 inch	**20-35 inch**	**35-50 inch**	**>50 inches**
2.9	2.5	0.5	0.05

The following Project design criteria would apply to all action alternatives of the Project to maintain adequate levels of LWD across the landscape:

- Retain three to five large downed logs per acre. Where available, three of the five required down logs per acre would be in the largest size classes, in decay classes 1, 2, and 3 (SNFPA S&G 10) (SNF LRMP 64d) and at least 20 inches in diameter and 20 feet in length would be retained (SNF LRMP, North Kings Deer Herd [NKDH] Management Plan, Bertram 1984).
- Avoid disturbing existing large down wood, greater than 20 inches in diameter and 20 feet long.

Provide for additional down woody material by leaving felled cull hazard trees (dead trees with less than 25 percent sound wood) on site, as needed to meet the three to five logs per acre requirement for down wood.

Table 32. Landscape Scale Assessment of Large Snags >15" DBH within French Project Area

Landscape acres by treatment group and severity class						Landscape snags per acre >15" dbh									
Proposed Treatments	Acres by Fire Severity (MHW, MHC, PPN, SMC only)					Snags/Acre by Fire Severity				Total Remaining Snags by Fire Severity Classes					**Weighted Average snags/acre remaining**
	High	Mod. to High	Mod.	Low	Grand Total	High (118 plots)	Mod. to High (27 plots)	Mod. (50 plots)	Low (61 plots)	High	Mod. to High	Mod.	Low	Total	
Snag Retention (outside proposed treatment areas)	2398.2	965.5	1117.1	2228.5	6709.3	27.9	26.0	25.6	20.8	66909.8	25102.5	28598.0	46352.8	166963.1	24.9
Proposed fire salvage (1st entry units)	1318.6	250.9	182.4	118.8	1870.7	4	4	4	4	5104.2	991.1	720.5	469.2	7285.1	4
Proposed fire salvage (2nd entry units - delayed insect/fire mortality)	251.4	159.4	179.4	217.1	807.2	4.0	4.0	4.0	4.0	1005.6	637.5	717.5	868.2	3228.8	4.0
Plantation	111.2	38.7	58.1	223.1	431.2	1	1	1	1	111.2	38.7	58.1	223.1	431.2	1.0
Hazard tree removal inner 150 ft buffer of roadsides	300.5	117.4	168.0	522.6	1108.5	0	0	0	0	0.0	0	0	0	0.0	0.0
Hazard tree removal outer 150 ft buffer of roadsides	265.4	103.1	162.7	463.7	995.0	20	20	20	20	5308.2	2062.6	3254.8	9274.0	19899.6	20.0
DFPZ	34.9	9.2	8.9	17.1	70.1	0	0	0	0	0.0	0	0	0	**0.0**	0.0
SCE power line	43.0	8.5	13.3	24.3	89.1	0	0	0	0	0.0	0	0	0	**0.0**	0.0
Total of all proposed treatments	2325.0	687.2	772.9	1586.7	5371.7					78439.0	28832.4	33348.9	57187.4	197807.7	**16.4**

California Spotted Owl

The California spotted owl is designated by the Regional Forester as a FSS for the SNF. The SNF has 237 designated California spotted owl Protected Activity Centers (PACs) and 243 Home Range Core Areas (HRCAs). Protected Activity Centers are delineated around spotted owl territorial pairs or territorial individuals are compromised of the best available habitat encompassing 300 acres. The SNF LERMP as amended by the Sierra Nevada Forest Plan Amendment (2004) provides direction to designate PACs and HRCAs compromised of the best habitat using CWHR types 6, 5D, 5M, 4D, and 4M. These CWHR types are in essence considered suitable habitat (nesting and foraging) for California spotted owls. Pure eastside pine types are not considered suitable for California spotted owls.

The SNF has conducted surveys for spotted owl presence and reproductive status across the forest since the early 1980s. Approximately 200,000 acres of suitable habitat, which includes 3D and 3M habitat types, has been surveyed on the SNF following R-5 USDA Forest Service Protocol.

Background on the Species' Status

The U.S. Fish and Wildlife Service (USFWS); (U.S. Dept. of Interior 2006) issued its 12-month finding on a petition to list the California spotted owl as threatened or endangered. In its finding, published on 24 May 2006, the USFWS found that the petitioned action was not warranted. The USFWS went on to conclude that the scale, magnitude, or intensity of effects on the California spotted owl resulting from fire, fuels treatments, timber harvest, and other activities did not rise above the threshold necessitating protection of the species under the Endangered Species Act (ESA). Therefore, the California spotted owl's status remains unchanged. The California spotted owl is neither listed under the federal ESA, nor currently is it a candidate for listing. The Sacramento office of the USFWS no longer maintains a federal species of concern list (U.S. Fish and Wildlife Service 2006). On December 22, 2014, the USFWS was petitioned by the Wild Nature Institute and the John Muir Project of the Earth Island Institute to list the California spotted owl as a threatened or endangered species under the ESA. The listing status is currently under review by the Service, and to date they have not issued a 90-day finding.

Requirements for Home Range Suitability

California spotted owls, like the other two subspecies of spotted owls, use or select habitats for nesting, roosting, or foraging that have structural components of old forests, including large-diameter trees that are typically greater than 24 inches dbh, high tree density, multi-layered canopy/complex structure, and high canopy cover (greater than 40 percent and mostly greater than 70 percent) (Laymon 1988, Bias and Gutierrez 1992, LaHaye et al. 1992, Gutierrez et al. 1992, Zabel et al. 1992). About 80 percent of known sites are found in mixed-conifer forest.

Table 33. California Spotted Owl Habitats and Stages

Abbreviation	CWHR Habitats	CWHR Specific High and Moderate Capability Size, Canopy Cover, and Substrate Classes
MHC	Montane Hardwood-Conifer	4M, 4D, 5M, 5D, 6
MHW	Montane Hardwood	4M, 4D, 5M, 5D
PPN	Ponderosa Pine	4M, 4D, 5M, 5D
SMC	Sierra Mixed Conifer	4M, 4D, 5M, 5D, 6
RFR	Red Fir	4M, 4D, 5M, 5D, 6
WFR	White Fir	4M, 4D, 5M, 5D, 6
JPN	Jeffrey Pine	4M, 4D, 5M, 5D, 6

The table above shows the suitable habitat categories for spotted owl.

Gutiérrez et al. (1992) found that spotted owls preferentially use areas with at least 70 percent canopy cover, use habitats with 40 to 69 percent canopy cover in proportion to their availability, and spend less time in areas with less than 40 percent canopy cover than expected if habitat were selected randomly. California spotted owls in the Sierra Nevada prefer stands with substantially greater canopy cover, total live-tree basal area, basal area of hardwoods and conifers, and snag basal area for nesting and roosting. Stands suitable for nesting and roosting have: (1) Two or more canopy layers; (2) dominant and co-dominant trees in the canopy averaging at least 24 inches dbh; (3) at least 70 percent total canopy cover (including the hardwood component); (4) higher than average levels of very large, old trees; and (5) higher-than-average levels of snags and downed woody material (Gutierrez et al. 1992).

Spotted owl pairs have large home ranges that may overlap those of other spotted owls (Verner et al. 1992). Estimates of California spotted owl home-range size are extremely variable. All available data indicate that they are smallest in habitats at relatively low elevations that are dominated by hardwoods, intermediate in size in conifer forests in the central Sierra Nevada, and largest in the true fir forests in the northern Sierra Nevada (Zabel et al. 1992, USFS 2001). Based on an analysis of data from radio telemetry studies of California spotted owls, mean home-range sizes of breeding season pairs were estimated at 3,642 hectares (ha) (9,000 acres (ac)) in true fir forests on the Lassen National Forest, 1,902 ha (4,700 ac) in mixed conifer forests on the Tahoe and Eldorado National Forests, and 1,012 ha (2,500 ac) in mixed conifer forests on the SNF (USFS 2001).

Spotted Owl Habitat

Spotted owls show strong associations with mature forest conditions for nesting and roosting (Keane 2014). “Recent research includes observational studies that describe associations between habitat and spotted owl occurrence, occupancy, and demographic parameters (survival, reproduction, habitat fitness potential) at the core area and home range scales (Blakesley et al. 2005; Dugger et al. 2005, 2011; Franklin et al. 2000; Gaines et al. 2010; Irwin et al. 2004; Kroll

et al. 2010; Lee and Irwin 2005; McComb et al. 2002; Olson et al. 2004; Seamans and Gutiérrez 2007a as cited in Keane 2014). Although the size of the analysis areas varied across studies, habitat associations were generally assessed at similar spatial scales (core areas or home range scales) around spotted owl nests and roost or activity centers. Vegetation classifications and habitat definitions also varied across studies, but the studies generally defined spotted owl habitat as stands with large trees and high canopy cover (hereafter referred to as mature forest; see individual studies for specific definitions of habitat used in each)" (Keane 2014, emphasis added).

Nesting Habitat

Verner et al (1992) report that micro habitats used for nesting typically have greater than 70 percent total canopy cover (all canopy above 7 feet), except at very high elevations where canopy cover as low as 30-40 percent may occur (as in some red fir stands of the Sierra Nevada). Nest stands typically exhibit a mixture of tree sizes and usually at least two canopy layers, and some very large, old trees are usually present. Often these have large, natural cavities, broken tops, and/or dwarf mistletoe brooms. Nest stands in conifer forests usually have some large snags and an accumulation of fallen logs and limbs on the ground; downed woody debris is not a major component of nest sites in lower-elevation riparian/hardwood forests. Spotted owls do not build their own nests but depend mainly on finding a suitable, naturally occurring site. Nest heights vary regionally-about 38 feet in riparian/hardwood forests at lower elevations, and about 65 and 57 feet in conifer forests of the northern and southern Sierra Nevada. In Sierra conifer forests, nests are usually in cavities or on broken-topped trees or snags. Less often they are on platforms associated with abandoned raptor nests, squirrel nests, dwarf mistletoe brooms, or debris accumulations in trees. Cavity nests dominate nest types of California spotted owls in the Sierra Nevada. Nest trees are typically large (dbh of about 45 inches) for nest trees in Sierra conifer forests and decadent. Some owl pairs use the same nest cavity or platform repeatedly from year to year, some select new sites each year, and yet other alternate nest sites over time (Forsman et al. 1984).

Roosting Habitat

Verner et al (1992) found that stands used for roosting are similar to those used for nesting, with relatively high canopy cover, dominated by older trees with large diameters, and with at least two canopy layers. Studies of roosting northern spotted owls indicate that they respond to variation in temperature and exposure by moving higher or lower within the canopy, or around the roost tree, to access more comfortable microclimates (Forsman et al. 1984). The structure of multistoried stands characteristic of roost sites facilitates this movement.

Spotted Owl Use of Burned Habitat

There is important uncertainty and disagreement in the scientific literature about the extent to which spotted owls use burned forests. There is general agreement in the scientific community that owls rely on large-diameter, closed canopy forests for nesting, roosting, and successfully reproducing. Large acreages of such forests are being lost in large, high-intensity wildfires such as the Rim fire of 2013 and the King and French Fires of 2014. "The extent to which owls forage in areas burned by severe wildfires remains unclear, as does the extent to which owls can persist over the long-term in areas subjected to a broad extent of high-intensity wildfires. Existing studies on the value of high-intensity burned forests to spotted owls and the impacts of salvage logging on that value are too few." (personal communication, Pat Manley). Further research is required to clarify the contribution, if any, that burned forests make to supporting owl populations, particularly in large, high-intensity fires such as the French Fire.

Results of limited empirical research on the effects of wildfire on California spotted owl habitat are ambiguous. In a study of southern Sierra Nevada California spotted owl use of habitat for nesting, roosting, and foraging four years after a wildfire, Bond et al. (2009) found that spotted owl pairs in all 4 territories (1 unburned, 1 burned at low severity, and 2 burned at moderate severity) attempted to nest. For roosting during the breeding season, spotted owls selected low-severity burned forest and avoided moderate- and high-severity burned areas. Unburned forest was used in proportion to its availability (Bond 2009). Bond reports that most owls foraged in high-severity burned forests more than all other burn categories, and that high-severity burned forests had greater basal area of snags and higher shrub and herbaceous cover, parameters thought to be associated with increased abundance or accessibility of prey.

The Bond et al. 2009 study does not demonstrate that spotted owls rely on severely burned forests. First, the study was conducted in a post-fire landscape that has a much lower proportion of high-intensity fire (approximately 13%) as compared to the French Fire, where high intensity fire (>75% basal area loss) occurred over 40% of the landscape. Thus high-intensity fire was a relatively rare feature in the Bond et al. 2009 study area, compared to it being a predominant condition over large areas of the French Fire. Second, she found that in her study area, the 7 birds that she studied used the relatively small proportion of the landscape (~7% in the dominant vegetation type) that was in high-severity burn greater than expected (36 of 284 locations, or 11%). This nominal differential use does not demonstrate reliance; rather it indicates preferential use that just as readily could be attributed to edge effects (other studies have shown owls have a preference for foraging around habitat edges, e.g. Eyes 2014, Tempel 2014) as opposed to burned forest conditions. Third, Bond et al. 2009 recommends that no salvage logging be conducted within 1.5 km of spotted owl activity centers because owls rely on this zone and concentrate much of their foraging efforts within it, however the data in her 2009 paper does not support this conclusion. The average distance of the farthest foraging location reported by Bond et al. 2009 was 2.1 km, with the greatest distance being 3.4 km from an activity center. Bond et al. (2009) actually demonstrates spotted owls strong preference for foraging much closer to their activity center (within 500 meters) after which use declines precipitously (Manley, personal communication).

There is an important distinction between habitat use and habitat suitability. Bond et al. (2009) only addresses the former, as no information related to California spotted owl demography or occupancy rates or habitat quality measures were evaluated in this brief study. Moreover, the results from Bond et al. (2009) are highly limited due to (1) extremely low effective sample size (e.g., owl pairs are not independent during the nesting season), (2) lack of pre-fire data, and (3) lack of information as to whether studied owls were inexperienced population ‘floaters’ or pre-fire residents, and (4) limited sample size, area, and extent of vegetation plots. Consequently, not all high-severity burned areas can be considered suitable habitat for California spotted owls and further research will be required to thoroughly evaluate this question. “Additional research is needed to determine precise effects of different severities of fire and associated patch sizes on populations of California spotted owl prey, whether increased prey abundance or access ultimately provides an ecologically noteworthy benefit to spotted owls or other predators, and the duration of any such effects” (Bond et al 2009).

Spotted owls may use small patches of high-severity burned areas as foraging grounds (Bond et al. 2009). However, Clark’s (2007) thesis documents that in post-fire landscapes of the Southern Cascades, Northern Spotted owls have (1) increased extinction rates (increased mortality and emigration rates), (2) decreased population reproductive output, (3) increased home range size, and (4) decreased occupancy rates. Clark (2007) notes that the “relative use of [nesting, roosting,

and foraging] habitat within high severity burn was low compared to other habitats and likely suggests that these stands do not provide high quality habitat for spotted owls". High severity burned areas consisted of less than 5% of the proportion of used locations for spotted owls residing both inside and outside the wildfire perimeters (Clark, 2007).

In sum, the most we can confidently say with current information is that owls rely primarily on closed-canopy forests for nesting, roosting, and foraging; that they have been detected foraging in burned forests; and that salvage logging in high intensity burned forest may have the potential to impact the value of burned forests in situations where they have some value. Further research is needed before any conclusions can be drawn about the extent to which owls need or even use severely burned, unlogged forests near their nests.

Occurrence in Project Area

There are four California spotted owl PACs and HRCAs within the Project area (Figure 10). The table below shows the status of the owls, prior to the fire, along with the most current year for detection and survey results. Spotted owl surveys using the Region 5 protocol (USDA FS 2006b) are planned for the French Fire beginning in April 2015. A total of six visits will be conducted to each survey route. A map of the survey routes/call points is displayed in Figure 11. This is consistent with recommendations by Lee et al. (2012) that post-fire surveys should be conducted to determine owl use of habitat post-fire. If an action alternative is selected for the Project, an LOP would be implemented around each owl activity center in accordance with SNF LERMP as amended by the SNFPA Standard and Guideline 75.

To limit the potential for disturbance to nesting California spotted owls, an LOP would be in effect from March 1 through August 15 for ¼ mile surrounding the owl activity center unless surveys confirm that California spotted owls are not nesting (USDA FS 2015a, USFS 2004 S&G 75). The LOP would prohibit intensive mechanical activities (such as commercial-sized timber harvest) during the time period when reproductive owls and fledglings are most vulnerable to disturbance. Less invasive activities that are limited in scope and duration such as post-harvest slash piling and burning, invasive weed removal, herbicide application, hand-thinning of biomass trees <10" dbh, and conifer planting may occur during the LOP. The LOP would be applied to all action alternatives.

Table 34. PACs within the French Fire boundary and Past Survey Results.

PAC	Last Recorded Status	Year of Last Recorded Status
MAD0023	Reproducing	1991
MAD0123	Single	1991
MAD0045	Single	1991
MAD0046	Pair	2014

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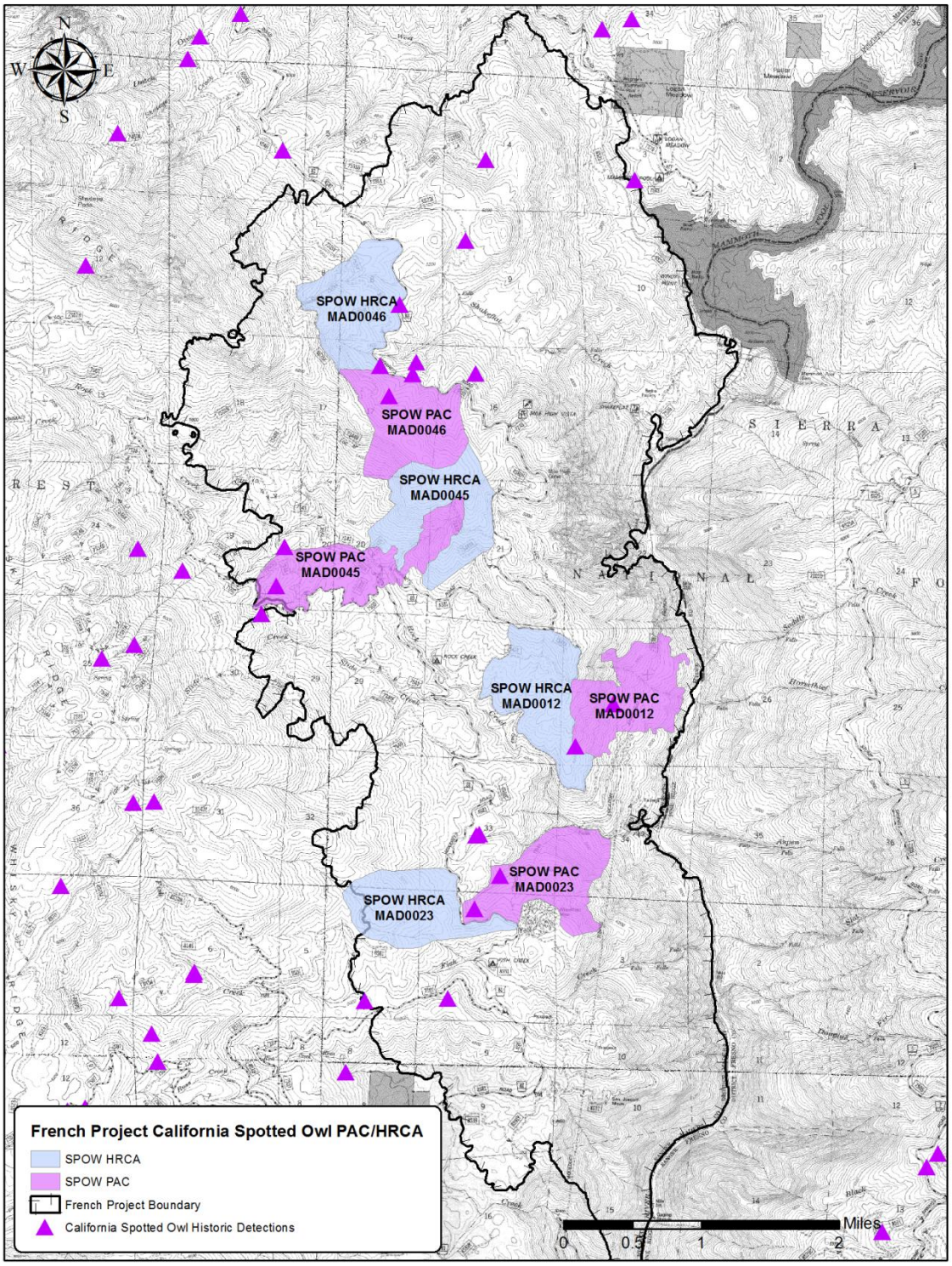

Figure 23. Spotted Owl PACS and HRCAs with Historic Spotted Owl detection points within French Fire boundary

3.9.2. Environmental Consequences

The four spotted owl PACs and HRCAs within the French Fire area experienced mostly high severity fire effects (Table 36 and Figure 23). Cumulatively, over half (52%) of these areas experienced high severity fire (>75% basal area mortality), with an additional 13% of the areas experiencing moderate severity based on RAVG (50-75% basal area mortality) which plot data indicates is actually high severity (83% basal area mortality).

MAD12: This PAC experienced 38% high severity fire effects (>75% BA mortality) and an additional 44% moderate fire effects (25-75% BA mortality). The HRCA experienced much higher severity fire effects with 79% high (>75% BA mortality) and an additional 19% moderate.

MAD23: This PAC experienced 71% high severity fire effects (>75% BA mortality) and an additional 25% moderate (25-75%). The HRCA experienced less severe fire effects with 42% burned at high severity (>75% BA mortality) and 31% burned at moderate (25-75% BA mortality).

MAD45: This PAC only experienced 18% high severity fire effects (>75% BA mortality) and an additional 22% moderate (25-75% BA mortality). The HRCA burned much more severe with 66% high severity (>75% BA mortality) and an additional 22% moderate severity (25-75% BA mortality).

MAD46: This PAC experienced 27% high severity fire effects (>75% BA mortality) and an additional 34% moderate (25-75% BA mortality). The HRCA burned much more severe with 70% high severity fire effects (>75% BA mortality) and an additional 19% moderate (25-75% BA mortality).

Table 35. Acres of Spotted Owl PACs/HRCAs displayed by RAVG Burn Mortality Categories.

RAVG Basal Area Mortality Categories	Spotted Owl HRCAs				Spotted Owl PACs				Grand Total
	MAD 0012	MAD 0023	MAD 0045	MAD 0046	MAD 0012	MAD 0023	MAD 0045	MAD 0046	
0% BA mortality	1	8	5	2	3	0	30	5	**55**
0-10% BA mortality	6	36	13	14	13	2	98	55	**238**
10-25% BA mortality	10	29	19	16	38	9	52	57	**228**
25-50% BA mortality	22	42	29	31	68	30	41	55	**319**
50-75% BA mortality	29	39	36	28	60	45	28	47	**313**
75-90% BA mortality	25	24	34	20	23	41	15	26	**208**
>90% BA mortality	234	87	170	195	89	177	38	55	**1045**
Grand Totals	**328**	**263**	**307**	**306**	**293**	**306**	**301**	**301**	**2405**

Table 36. California Spotted Owl Nesting and Foraging CWHR Habitats across the Entire French Fire area by Burn Severity/RAVG Basal Area Loss Classes.

CWHR Habitat Type	0% BA mort	0% <= BA mort < 10%	10% <= BA mort < 25%	25% <= BA mort < 50%	50% <= BA mort < 75%	75% <= BA mort < 90%	BA mort >= 90%	Grand Total
MHC4D	51	252	276	347	283	168	528	1905
MHC4M	36	106	78	107	101	64	294	787
MHC5D	4	9	6	5	3	4	18	48
MHC5M	5	10	6	6	4	2	17	50
MHW4D	66	260	314	454	389	244	808	2536
MHW4M	18	21	24	27	27	20	58	194
MHW5D	3	5	3	6	4	2	11	34
PPN4D	52	239	178	221	198	130	501	1519
PPN4M	20	32	27	27	24	21	60	212
PPN5D	11	52	27	24	15	9	39	179
PPN5M	5	5	2	2	1	0	1	15
SMC4D	72	319	224	219	164	122	397	1519
SMC4M	22	36	32	40	37	21	94	282
SMC5D	17	42	20	17	10	7	19	133
SMC5M	2	11	12	13	10	5	20	73
Grand Totals	**384**	**1397**	**1231**	**1515**	**1271**	**820**	**2866**	**9484**

Prior to the French Fire, there were 9,484 acres of suitable spotted owl habitat within the Project area (Table 37). Over one-third (39% or 3,686 acres) of the habitat experienced high severity fire effects (>75% basal area mortality) resulting in high basal area loss and decreased canopy cover (3-7% post fire canopy). Additionally, plot data indicates that areas RAVG typed as moderate burn severity (50-75% basal area mortality) experienced high severity effects (~88% mortality) indicating that owl nesting and roosting habitat was reduced by another 1,271 acres. In sum, 4,957 acres (52%) of pre-fire owl nesting and roosting habitat experienced high severity fire effects and is no longer suitable for these purposes. Owls may forage in some of the high severity burn areas. If so, they are likely to concentrate foraging activities close to edges of remnant green forest and not venture into large contiguous blocks of high severity fire-affected forest where they may be vulnerable to predation.

Table 37. California spotted owl habitat within French Fire displayed with post-fire basal area mortality effects (summary table)

Before French Fire			French Fire Mortality Effects			
CWHR type (4MD, 5MD)	Acres	Percent of total fire area (13,830 acres)	Moderate/Low <50% BA Mortality		High >50% BA Mortality	
			Acres	Percent	Acres	Percent
MHC	2,790	20%	1,304	47%	1,486	53%
MHW	2,764	20%	1,200	43%	1,564	57%
PPN	1,924	14%	924	48%	1,000	52%

SMC	2,006	15%	1,099	55%	907	45%
Total	**9,484**	**69%**	**4,527**	**48%**	**4957**	**52%**

Select Management Direction (Spotted Owl PACs and HRCAs)

Within California spotted owl HRCAs: Where existing vegetative conditions permit, design projects to retain at least 50 percent canopy cover averaged within the treatment unit. Exceptions are allowed in limited situations where additional trees must be removed to adequately reduce ladder fuels, provide sufficient spacing for equipment operations, or minimize re-entry. Where 50 percent canopy cover retention cannot be met for reasons described above, retain at least 40 percent canopy cover averaged within the treatment unit (S&G 7).

Outside of WUI defense zones, salvage harvests are prohibited in PACs and known den sites unless a biological evaluation determines that the areas proposed for harvest are rendered unsuitable for the purpose they were intended by a catastrophic stand-replacing event (S&G 16). Road hazard tree removals may occur within PACs and HRCAs.

Spatial and Temporal Context for Effects Analysis

The analysis area is defined as the French Fire and the Forest boundary. Unless otherwise noted, the analysis area is equivalent to the Project area. The French Fire perimeter was chosen as the analysis area because the proposed actions would treat and modify burned areas. Therefore, selection of the total area that burned within the fire area for analysis provides a more appropriate context for reasonable determination of effects to habitat (and the species associated with this habitat) proposed for treatment. For the purpose of the wildlife analysis, the temporal bounds include 30 year horizon for future effects because modeling indicates that within the timeframe the treated stands would approach stocking levels corresponding with forest development (i.e. young forested stands could develop within this timeframe, and unburned stands could grow into denser and larger forest).

3.9.3. Alternative 1 (No Action)

Direct and Indirect Effects

Of the 13,832 acre Project area, 9,484 acres **Error! Reference source not found.**(Table 38) were uitable spotted owl habitat prior to the French Fire. Of that acre total, 4,957 acres are in high/moderate mortality category and 4,527 acres are in moderate/low RAVG mortality category. Under this alternative no treatments would occur. This would eventually leave high amounts of downed wood on the ground because the trees would not be salvaged. The development of future habitat would be delayed because reforestation would not occur.

The indirect effects of no action would include an increased fuel hazard for future wildfire and related impacts on habitat development and recovery (Stalter 2015). The fuel loads left behind by this alternative would make potential wildfires in the area difficult to suppress and could create a more intense burn and would result in higher severity effects to vegetation and habitat. Increased rates of fire intensity would result in potential loss of suitable nesting habitat and other habitat attributes such as large trees and snags and down woody material.

The indirect effects of relying on natural establishment of conifers in high/moderate severity areas would be delayed and variable establishment of conifers and areas dominated by shrubs. Within 50 years, conifer establishment under this alternative (where it does occur naturally) is

projected to be equivalent to CWHR size class 2 (sapling, 1-6 inches dbh) and canopy closure S (10-24% canopy cover) (Smith 2015) which is not suitable spotted owl habitat. Large contiguous areas of conifer forest that experienced high severity fire would be dominated by chaparral/brush as there would be no seed source for new trees to colonize these areas.

Under this alternative, future suitable habitat for productive owl territories as a result of fire would become patchy or unevenly distributed, and the abundance of owls in the wildlife analysis area could decline. As cited in Bond (2009), Franklin et al. (2000) hypothesized that fire could enhance prey abundance and access to prey by creating patchy openings within otherwise closed forest canopy and by increasing habitat edges. Several years post fire, there would be an increase in ground cover which would benefit common owl prey species such as dusky-footed woodrat and northern flying squirrel. Owls may forage in these areas, leading to a short term benefit for the owl. As shown in Bond et al (2009), owls roosting during the breeding season selected low-severity burned forest and avoided moderate- and high-severity burned areas. Unburned forest was used in proportion to its availability.

In sum, if trees killed by the French Fire are not removed, they would provide fuel for future wildlife(s) that could also threaten various wildlife species and their habitat. Many species that presently exist within or near the Project are, such as the California spotted owl, rely on stands of live trees. If existing fuels are not removed and there is another fire in or around the Project area (Stalter 2015) additional habitat for these species will be lost, above and beyond what was lost in the French Fire. Conversely, if the Project is implemented, the risk of stand-replacing fires would be reduced and existing habitat would be retained.

3.9.4. Alternative 2 (Proposed Action)

Direct and Indirect Effects

Moderate/Low severity burned habitat

A total of 1,929 acres of fire-affected (0-50% Basal area mortality) spotted owl habitat are proposed to be treated under Alternatives 2 and 3. It is expected these areas could be used by spotted owls as suitable nesting habitat in those areas that still support a considerable green tree component. Most of these acres (1,109 acres) are in the roadside hazard buffer, which proposes to remove hazard trees within a 300 foot buffer along approximately 64 miles of roadsides within the project boundary. The remaining acres are within first entry units (255 acres), secondary entry units (351 acres), plantations (168 acres) and powerline/DFPZ treatment areas (46 acres).

High Severity burned habitat

A total of 2,524 acres of fire-affected (50-100% Basal area mortality) spotted owl habitat are proposed to be treated under the Alternatives 2 and 3. It is expected that these areas would be used as potential foraging habitat by spotted owls, but would not be utilized as nesting or roosting habitat. The majority of these acres are within the first entry units (1,402), although many of these units also overlap the road hazard treatment areas. The remaining acres are within the roadside hazard treatment areas (641 acres), secondary entry units (351 acres), plantations (54 acres) and powerline/DFPZ treatment areas (75 acres).

Prior to the French Fire, there were 9,484 acres of suitable spotted owl habitat within the project area. Over one-third (39% or 3,686 acres) of the habitat experienced high severity fire effects (>75% basal area mortality) resulting in high basal area loss and decreased canopy cover (3-7%

post fire canopy). Additionally, plot data indicates that areas RAVG typed as moderate burn severity (50-75% basal area mortality) experienced high severity effects (~88% mortality) indicating that owl nesting and roosting habitat was reduced by another 1,271 acres. In sum, 4,957 acres (52%) of pre-fire owl nesting and roosting habitat experienced high severity fire effects and is no longer suitable for these purposes. Owls may forage in some of the high severity burn areas. If so, they are likely to concentrate foraging activities close to edges of remnant green forest and not venture into large contiguous blocks of high severity fire-affected forest where they may be vulnerable to predation.

In areas proposed for treatment, 2,524 acres are in the high mortality fire-affected stands that no longer provide suitable owl nesting and roosting habitat. Owls may forage in areas that have experience high severity fire. Most of the pre-fire habitat (53%) would not be treated. A total of 2,434 acres of high severity fire-affected spotted owl foraging habitat would remain untreated throughout the fire area, and an additional 2,601 acres of moderate/low severity fire-affected habitat would remain untreated, providing large patches of snag habitat for owls to use as foraging areas. These untreated areas would support various densities of fire-killed trees that will naturally decay and contributing to downed wood, and in the future, some of the trees within low severity burned areas may develop into more suitable habitat for some owl prey species as well as areas for nesting, foraging and roosting for spotted owls.

Removal of snags in suitable habitat may reduce the quantity of prey species nesting habitat, such as northern flying squirrel, and remove possible hunting perch snags for the owl. However, no live canopy cover would be removed from the salvage treatment areas, and owls tend to perch and roost within dense live canopy closure for protection from predators such as great horned owls. The salvage treatment areas would retain their existing levels of live trees and canopy cover, both of which are important elements of owl habitat. While the hazard tree removal and landing creation could remove an occasional live tree that posed a threat to a specified road or trail, stand-level tree size distribution and canopy cover would not be affected by such minor removals.

Salvage treatments would retain an average of four snags per acre across the treated areas. Virtually no snags would remain in the inner 150’ roadside hazard buffer, however snag retention zones delineated within first and secondary entry units would retain additional snags to make up for this deficit along roadsides. A majority of the conifer and hardwood vegetation types throughout the project (6,709 acres or 56% of the project area) would retain an average of 24.9 snags per acre because these acres are outside of proposed treatment areas. Table 33 shows the number of large snags (>15” dbh) per acre within conifer and hardwood dominated vegetation types. The information is displayed by proposed treatment: snag retention, proposed fire salvage (first and secondary entry), Roadside hazard removals, DFPZ, and powerline. The table displays data for both Alternatives 2 and 3. Considering the current weighted average of snags across the French landscape is 24.9 snags/acre, and the projected weighted average for snags retained is 16.4 snags/acre, there would be a reduction of 8 snags/acre across the landscape. This does not appear to be a major reduction in snags across the landscape.

Potential direct effects on spotted owls may result from the modification or loss of habitat or habitat components; however, we do not expect these treatments will have substantial adverse effects to spotted owls populations in or near the project area particularly when considering the salvage operations will occur in a relatively small area of potential suitable habitat and that those salvage operations will most exclusively remove dead or dying trees while retaining the current forest canopy cover. The proposed reforestation treatments also will help promote a quicker

return to a forested condition, as compared with natural regeneration. The pre-fire canopy cover of this habitat ranges between 48 to 55 percent canopy cover. Post fire canopy cover now measures from 3 to 7 percent in the high and moderate severity burn areas, to 14 to 32 percent canopy cover in the moderate to low severity burn areas. With the implementation of Alternative 2, it is estimated that with the reforestation proposed under Alternative 2, the canopy cover would respond back to pre-fire condition within a 30 year period. Within 50 years, the reforested areas are projected to be CWHR 4D (12-15" dbh and canopy cover 60-100%).

As an example, the source point fire plantings that occurred in 1962-1972 on the High Sierra Ranger District across the river canyon from the French Fire ranged in size and canopy density from approximately 10 to 15 inches DBH and 35 to 60 percent canopy cover in 1993. CWHR size and density classes in these 20 to 30 year old stands included 3P, 3M, and 4M (Rojas 2014). At the time of the French Fire, these 40 to 50 year old stands had attained structures consistent with spotted owl foraging and nesting habitat equivalent to CWHR 4M and 4D.

Disturbance associated with logging, temporary road construction, or other associated activities within or adjacent to occupied habitat may disrupt nesting, fledgling and foraging activities; however, implementation of appropriate LOPs around spotted owl activity centers would decrease any potentially disturbing effects associated with project activities.

In summary, using CWHR criteria, implementation of Alternative 2 would not result in any additional reduction of spotted owl nesting and roosting habitat beyond what was caused by the French Fire. Proposed activities would not further reduce canopy cover because no live trees would be removed. Project activities also could temporarily reduce prey availability through loss of habitat, mortality of small mammals or behavioral changes. Because prey species have relatively rapid reproduction rates, this effect would be expected to be short-term in duration. Sufficient acres of high and moderate severity fire-affected habitat would be retained for owls to utilize when foraging. Sufficient levels of snags and large woody debris would be retained across the landscape to provide legacy structures for spotted owls. Future risk of catastrophic fire in the project area would be reduced since fuels would be removed in key strategic areas which would protect future habitat from effects of severe, stand-replacing fire.

3.9.5. Alternative 3 (No Herbicide)

Direct and Indirect Effects

Alternative 3 proposes the same treatments as alternative 2 except that no herbicides would be used to accomplish reforestation or noxious weed eradication. The direct and indirect effects to owls from this alternative would be similar to those discussed under alternative 2, however habitat recovery could be delayed greatly due to the competition from bear clover and manzanita on planted pines and cedar within the reforestation areas. Within 50 years, conifer establishment under this alternative is projected to be equivalent to CWHR size class 2 (sapling, 1-6 inches dbh) and canopy closure S (10-24% canopy cover) (Smith 2015) which is not suitable spotted owl habitat.

3.9.6. Alternative 4 (Hazard Tree and Plantation Salvage Only)

Direct and Indirect Effects

The direct and indirect effects to spotted owls would be similar to those discussed under Alternative 2. This alternative would only treat roadside hazard trees and existing plantations, along with DFPZ and powerline corridor areas.

Moderate/Low severity burned habitat

A total of 1,590 acres of fire-affected (0-50% Basal area mortality) spotted owl habitat are proposed to be treated under Alternative 4. It is expected these areas could be used by spotted owls as suitable nesting habitat in those areas that still support a considerable green tree component. Most of these acres (1,413 acres) are in the roadside hazard buffer, which proposes to remove hazard trees within a 300 foot buffer along approximately 64 miles of roadsides within the project boundary. The remaining acres are within plantations (118 acres) and powerline/DFPZ treatment areas (57 acres).

High Severity burned habitat

A total of 1,488 acres of fire-affected (50-100% Basal area mortality) spotted owl habitat are proposed to be treated under the Alternative 4. It is expected that these areas would be used as potential foraging habitat by spotted owls, but would not be utilized as nesting or roosting habitat. The majority of these acres (1,264 acres) are within the roadside hazard buffer, which proposes to remove hazard trees within a 300 foot buffer along approximately 64 miles of roadsides within the project boundary. The remaining acres are within plantations (101 acres) and powerline/DFPZ treatment areas (124 acres). Alternative 4 would retain 21.4 snags/acre across the landscape since treatments would only occur along roadsides and within existing plantations.

Prior to the French Fire, there were 9,484 acres of suitable spotted owl habitat within the project area. Over one-third (39% or 3,686 acres) of the habitat experienced high severity fire effects (>75% basal area mortality) resulting in high basal area loss and decreased canopy cover (3-7% post fire canopy). Additionally, plot data indicates that areas RAVG typed as moderate burn severity (50-75% basal area mortality) experienced high severity effects (~88% mortality) indicating that owl nesting and roosting habitat was reduced by another 1,271 acres. In sum, 4,957 acres (52%) of pre-fire owl nesting and roosting habitat experienced high severity fire effects and is no longer suitable for these purposes. Owls may forage in some of the high severity burn areas. If so, they are likely to concentrate foraging activities close to edges of remnant green forest and not venture into large contiguous blocks of high severity fire-affected forest where they may be vulnerable to predation.

1,376 fewer acres of fire-affected spotted owl habitat would be treated and reforested under this alternative which could lead to future habitat fragmentation in areas that are not reforested. In the short term, more potential foraging habitat would be retained if the owls do forage within the high severity burn areas, however this would be at the expense of reforesting areas to provide suitable nesting and roosting habitat in the future, which would be detrimental to the establishment of spotted owl habitat in the foreseeable future

3.9.7. Alternative 5 (No Secondary Entry)

Direct and Indirect Effects

The direct and indirect effects to spotted owls would be similar to those discussed under Alternative 2. Alternative 5 is similar to the proposed action except that secondary salvage areas (910 acres) are not proposed for treatment and subsequent reforestation, 390 of which were suitable spotted owl habitat prior to the French Fire. Alternative 5 would retain 17.8 snags/acre since treatments would not occur in the areas proposed for secondary salvage under the proposed action.

Moderate/Low severity burned habitat

A total of 1,754 acres of fire-affected (0-50% Basal area mortality) spotted owl habitat are proposed to be treated under Alternative 5. It is expected these areas could be used by spotted owls as suitable nesting habitat in those areas that still support a considerable green tree component. Most of these acres (1,283 acres) are in the roadside hazard buffer, which proposes to remove hazard trees within a 300 foot buffer along approximately 64 miles of roadsides within the project boundary. The remaining acres are within first entry units (242 acres), plantations (178 acres) and powerline/DFPZ treatment areas (50 acres).

High Severity burned habitat

A total of 2,309 acres of fire-affected (50-100% Basal area mortality) spotted owl habitat are proposed to be treated under the Alternative 5. It is expected that these areas would be used as potential foraging habitat by spotted owls, but would not be utilized as nesting or roosting habitat. The majority of these acres are within the first entry units (1,370), although many of these units also overlap the road hazard treatment areas. The remaining acres are within the roadside hazard treatment areas (791 acres), plantations (65 acres) and powerline/DFPZ treatment areas (82 acres).

In sum, the direct and indirect effects of Alternative 5 would be the same as those discussed under Alternative 2, except that slightly less spotted owl habitat would be treated (390 fewer acres). Slightly less disturbance and reforestation would occur within the project area. However the differences are so small as to be negligible

Cumulative Effects

The largest impact to the spotted owl was the French Fire. Other past fires within the area did not occur within primary suitable habitat and so the French Fire is the greatest factor in the loss of habitat within this area.

Over time, the remaining suitable habitat would improve naturally as the result of snag and down log creation and increased vegetation structural complexity, as well as higher canopy cover. After 30 years, remaining forest would become more suitable, and plantations would be in the early to mid-seral stage.

As a result of the French Fire, many trees along NFS roads were damaged and could fall into the roadway, posing a safety and access hazard to area residents and landowners, Forest Service personnel and contractors, special use permit holders, and the visiting public. Bass Lake Ranger District is currently implementing the Mile High Roadside Hazard Tree Removal Project on approximately 250 acres along forest road 4S81. The majority of hazard trees proposed for

removal occur in high severity burned areas; however, hazard trees within mixed severity burned areas would also be included to ensure the safety of road users in all those areas where burned trees pose a genuine risk of falling into the roadway. These activities would have minimal effect on spotted owl habitat in the analysis area.

The cumulative removal of fire-killed trees would modify burned habitat with fire-killed tree structure removal, but would not reduce current spotted owl PAC/HRCA occupancy, distribution, or the spotted owl population on the Forest above that resulting from the wildfire because the post-fire environment is currently in a deforested condition with little to no canopy cover component. Based on spotted owl survey results, implementation of fire-killed or hazard tree removal would be subject to a LOP that would restrict tree removal during the nesting season (March 1 to August 15).

While there are short-term effects (loss of snags and down woody material), the horizontal and vertical diversity of forest vegetation structure and species would be improved over time. Snags presently are, and would continue to be deficient in burned early-seral plantations (plantations prior to the fire) that are replanted; however the limited extent of the proposed salvage actions does not diminish the number of snags that are needed by this species across the landscape. Down wood would also increase over time, continuing to contribute to large logs on the landscape as snags fall and trees get older and die. Overall, alternatives, especially alternative 2 do not have a substantial cumulative impact to spotted owls or their habitats, when considering past, present, and foreseeable future actions. This conclusion is particularly evident when considering that a majority of the burned area would not be treated, that the treatments only remove dead trees and the actions would only occur during a limited temporal period.

Northern goshawk

The northern goshawk is designated as a FSS in Region 5. Northern goshawks occur in a variety of coniferous forest communities in the western United States, including ponderosa pine (*Pinus ponderosa*), Jeffrey pine (*P. jeffereyi*), mixed conifer, white fir (*Abies concolor*), and lodgepole pine (*P. contorta*). Large snags and downed logs are believed to be important components of northern goshawk foraging habitat because such features increase the abundance of major prey species. When foraging, northern goshawks utilize a wider range of forest types and conditions, but most populations still exhibit a preference for high canopy closure and a high density of larger trees (Reynolds et al. 1992).

There are currently 65,590 acres of suitable goshawk high nesting habitat on the SNF as defined by CWHR types MHC, PPN, SMC, WFR, MRI, JPN, LPN, SCN, MHW and 4M, 4D, 5M, 5D, and 6 (see Table 36). Foraging habitat includes all those for nesting plus 5P and 5S. Moderate nesting habitat is ASP (6, 5D, 5M, 4D and 4M), RFR 4D and 4M, LPN and SCN 3D and 3M. Suitable goshawk habitat is similar to spotted owl habitat, except that they utilize smaller diameter trees and less dense canopy. Suitable goshawk habitat at a minimum consists of conifer forest stands with 11” or higher average dbh and a canopy cover of 40-59%. Habitat suitable for goshawk nesting and fledgling is generally of higher canopy closure, $\geq$ 60%, with snags and downed logs for prey habitat.

Table 38. CWHR type for Northern goshawk high nesting and foraging habitat and moderate nesting habitat

Abbreviation	CWHR Habitats	CWHR Specific High and Moderate Capability Size, Canopy Cover, and Substrate Classes
High Nesting and Foraging Habitat		
JPN	Jeffrey Pine	4M, 4D, **5P, 5S,** 5M, 5D, 6
LPN	Lodepole Pine	4M, 4D, **5P, 5S,** 5M, 5D
MHC	Montane Hardwood-Conifer	4M, 4D, **5P, 5S,** 5M, 5D, 6
MHW	Montane Hardwood	4M, 4D, **5P, 5S,** 5M, 5D
MRI	Montane Riparian	4M, 4D, **5P, 5S,** 5M, 5D, 6
PPN	Ponderosa Pine	4M, 4D, **5P, 5S,** 5M, 5D
SMC	Sierra Mixed Conifer	4M, 4D, **5P, 5S,** 5M, 5D, 6
SCN	Subalpine Conifer	4M, 4D, **5P, 5S,** 5M, 5D
WFR	White Fir	4M, 4D, **5P, 5S,** 5M, 5D, 6
Moderate nesting habitat		
ASP	Aspen	4M, 4D, 5M, 5D, 6
LPN	Lodgepole Pine	3D, 3M
RFR	Red Fir	4M, 4D
SCN	Subalpine Conifer	3D, 3M

*Foraging habitat are all the CWHR types for nesting plus 5P and 5S

Northern goshawk territories are managed on the SNF as PACs as prescribed by the SNF LRMP as amended by the Sierra Nevada Forest Plan Amendment (USDA 2004). To date, the SNF has 56 known northern goshawk PACs and/or territories. As of 1998, 20 of the 55 territories have been incorporated into the Regional Forest Service database. They were included for submittal to the regional database based on the following criteria: 11 have at least one active nest site for which the nest location is known; four are historical nest sites for which the nest location is unknown; four are based on observations of young; two are based on observations of territorial defense or repeated sightings. The remaining 35 are based on incidental sightings of goshawk and/or suitable goshawk habitat.

As stated earlier, the PACs are 200 acres in size and are delineated based on all known and newly breeding territories detected on the Forest. The goshawk territories, which are approximately 175 acres, are based on historical information and a current nest site maybe unknown.

Occurrence in the Project Area

Prior to the fire, there were 9,498 acres of suitable habitat within the analysis area. There are no goshawk PACs and no incidental detections within the French Fire boundary. The following table shows the nesting and foraging habitat that was within the Project area prior to the fire as well as the conifer mortality that has occurred.

Table 39. Northern goshawk habitat within French Fire displayed with post-fire basal area mortality effects (summary table)

Before French Fire			French Fire Mortality Effects			
CWHR type (4MD, 5MDPS)	Acres	Percent of total fire area (13,830 acres)	Moderate/Low <50% BA Mortality		High >50% BA Mortality	
			Acres	Percent	Acres	Percent
MHC	2,790	20%	1,304	47%	1,486	53%
MHW	2,767	20%	1,201	43%	1,565	57%
PPN	1,925	14%	924	48%	1,000	52%
SMC	2,016	15%	1,103	55%	913	45%
Total	**9,498**	**69%**	**4,532**	**48%**	**4,964**	**52%**

Approximately 4,964 acres of goshawk experienced high basal area loss (>50%) during the French Fire and is no longer considered suitable nesting habitat. These areas may still be used as foraging habitat by goshawks, but due to the extreme changes in live tree basal area and canopy cover (reduction from 50% canopy cover down to an average of 5% canopy cover) these areas longer provide suitable nesting habitat.

Environmental Consequences

3.9.8. Alternative 1 – (No Action)

Direct and Indirect Effects

Under the No Action alternative the Project area would not be treated. If no treatments occurred within high/moderate fire severity areas goshawk habitat would develop slowly and be variable in distribution. No direct effects would occur to the goshawk because no additional action would take place. The greatest impact to the goshawk or goshawk habitat within the analysis area is the French Fire. Those portions of the analysis area that burned at high and moderate severity and no longer provide suitable goshawk habitat may remain unsuitable for goshawk nesting for the next 100-150 years under this alternative (Smith 2015). Intraspecific competition for suitable nesting and foraging habitat outside the burn area also may increase as fire-displaced goshawks from within the burn disperse in search of suitable habitat.

Indirect effects of no action include increased fuel hazard and the potential for future wildfire and its impact on habitat development and recovery. The fuel loads that would be left by this alternative would make potential wildfires in the area difficult to suppress and create a more intense burn, which could lead to increased rates of spread (Stalter 2015) resulting in potent loss of suitable goshawk nesting habitat and other important attributes such as large trees, large snags, and down woody material. The occurrence of another large fire within the analysis area would further fragment goshawk habitat, which could lead to reduced numbers of goshawks within the analysis area.

3.9.9. Alternative 2 – (Proposed Action)

Direct and Indirect Effects

A total of 9,498 acres of pre-fire suitable goshawk habitat existed in the Project area (Table 42). The majority of suitable habitat experienced high severity fire effects, has a canopy cover of 3-

7%, and is no longer considered suitable nesting habitat. Northern goshawks may forage in these areas; however, the high/moderate areas burn areas would not be utilized for nesting because the canopy cover and brush/understory component is no longer present.

Table 40. Summary of Proposed Action Treatment Acres by goshawk habitat type and burn severity

CWHR type	Total Acres in Project	No Treatment		Acres Proposed for Treatment by Mortality Class			
				Moderate/Low <50% BA mortality		High >50% BA mortality	
		Acres	Percent	Acres	Percent	Acres	Percent
MHC	2,790	1,340	48%	613	22%	839	30%
MHW	2,767	1,944	70%	305	11%	518	19%
PPN	1,925	887	46%	486	25%	551	29%
SMC	2,016	864	43%	530	26%	623	31%
Total	**9,498**	**5,035**	**53%**	**1,934**	**20%**	**2,531**	**27%**

A total of 1,934 acres of marginally suitable fire-affected (0-50% basal area mortality) goshawk habitat are proposed to be treated under Alternative 2. Most of these acres (1,110 acres) are in the roadside hazard buffer, which proposes to remove hazard trees within a 300 foot buffer along approximately 64 miles of roadsides within the Project boundary. The remaining acres are within first entry units (255 acres), secondary entry units (353 acres), plantations (168 acres) and powerline/DFPZ treatment areas (47 acres). A total of 2,531 acres of goshawk habitat which experienced high severity fire affects (>50% basal area mortality) is also proposed for treatment under this alternative, which could reduce the amount of goshawk foraging habitat in the Project area. Foraging habitat is not a limiting feature on the environment; therefore the potential effects to goshawk would be minimal. No treatment would occur across the majority of goshawk habitat (5,035 acres or 53%).

Alternative 2 includes reforestation of conifers to promote the reestablishment and development of a mature, closed canopy, conifer forest. This action alternative proposes to reforest up to 3,000 acres with ponderosa pine, sugar pine, and incense cedar forest types depending on elevation and location. Reforestation efforts would improve foraging habitat and accelerate stand development for future nesting habitat and over time, would alleviate the habitat fragmentation caused by large patches of high severity fire within the French Fire perimeter.

Dead or dying trees can provide nesting habitat for goshawks when they are located within dense stands of live trees. Analysis of snag habitat shows that there would be more than 90,500 large conifer snags (> 15 inches dbh) retained in the low and moderate mortality areas (<50% basal area loss) after alternative 2 treatments have been implemented (Table 33). This amount consists of all large snags retained in untreated areas, as well as an average of four snags per acre retained in treated areas according to the design criteria. Snags are proposed for retention along perennial

streams and are co-located with green forest where possible to increase the likelihood that goshawks would select these legacy structures in the near future.

3.9.10. Alternative 3 – (No Herbicide)

Direct and Indirect Effects

Alternative 3 consists of the same treatments as defined by Alternative 2; however, chemical methods of site preparation are replaced with a combination of hand and mechanical methods. Planting strategies would occur as described in alternative 2and release treatments are limited to hand and mechanical methods. Hand and mechanical methods would be used to meet the objective of retaining less than 20% brush cover on moderate and high productivity sites and less than 15% on low productivity sites. The potential direct effects would be the same as discussed under Alternative 2. Indirect effects to habitat recovery time may be an issue without the use of herbicides to control competing vegetation such as bear clover and manzanita within areas proposed for conifer reforestation. Ponderosa pine seedling survival can be as low as 20% when competing with bear clover. Additionally, this competition can cause as much as a 75% reduction in growth of ponderosa seedlings. It is likely that the reforestation under this alternative would be far less successful when compared to Alternative 2 (Smith, 2015) resulting in slower improvement of foraging habitat and slower stand development for future nesting habitat than Alternative 2. Habitat fragmentation may persist in areas where conifer reforestation is unsuccessful.

3.9.11. Alternative 4 – (Hazard Tree and Plantation Salvage Only)

Direct and Indirect Effects

Alternative 4 would only treat roadside hazards (2,684 acres), existing plantations (220 acres), and DFPZ/powerline areas (182 acres). No treatment would occur on the majority of pre-fire goshawk habitat 6,412 acres or 68% of the 9,498 acres of goshawk habitat in the Project area (Table 42).

Table 41, Summary of Alternative 4 Treatment Acres by goshawk habitat type and burn severity

CWHR type	Total Acres in Project	No Treatment		Acres Proposed for Treatment by Mortality Class			
				Moderate/Low <50% BA mortality		High >50% BA mortality	
		Acres	Percent	Acres	Percent	Acres	Percent
MHC	2,790	1,819	65%	493	18%	478	17%
MHW	2,767	2,170	78%	262	9%	336	12%
PPN	1,925	1,171	61%	416	22%	339	18%
SMC	2,016	1,252	62%	423	21%	341	17%

Total	**9,498**	**6,412**	**68%**	**1,594**	**17%**	**1,494**	**16%**

A total of 1,594 acres of marginally suitable fire-affected (0-50% basal area mortality) goshawk habitat are proposed to be treated under this alternative. Most of these acres (1,415 acres) are in the roadside hazard buffer. Removal of hazard trees are proposed within a 300 foot buffer along approximately 64 miles of roadsides within the Project boundary. The remaining acres are within plantations (119 acres) and powerline/DFPZ treatment areas (58 acres). A total of 1,494 acres of goshawk habitat which experienced high severity fire affects (>50% basal area mortality) are also proposed for treatment under this alternative, which could reduce the amount of goshawk foraging habitat in the Project area. Foraging habitat is not a limiting feature on the environment; therefore the potential effects to goshawk would be minimal.

Alternative 4 would treat 340 fewer acres of marginally suitable goshawk habitat when compared to Alternative 2 because no first or secondary treatment areas would be treated. Most of the first and secondary entry treatments proposed in Alternative 2 overlap with roadside hazard treatments, which is one reason why the actual treated acres is not very different between these two alternatives. More snags would be retained under this alternative when compared to alternative 2. Less of the forested areas that experienced stand-replacing fire would be treated and reforested under this alternative, which could lead to more population fragmentation than alternative 2.

3.9.12. Alternative 5 – (No Secondary Entry)

Direct and Indirect Effects

Alternative 5 is similar to alternative 2 except that secondary salvage areas (353 acres of suitable goshawk habitat) are not proposed for treatment and subsequent reforestation. The direct and indirect effects of Alternative 5 would be the same as those discussed under Alternative 2, except slightly less disturbance would occur due to the fact that less acreage is proposed for treatment.

Cumulative Effects

Cumulative effects on the goshawk could occur with the incremental loss of the quantity and and/or quality of habitat for this species. Overall, increases in recreational use of Forest Service system lands, and the utilization of natural resources on state, private and federal lands may contribute to habitat loss for the species. High intensity stand replacement fires have contributed and would continue to contribute to loss of habitat for this species.

Bass Lake Ranger District is currently implementing the Mile High Roadside Hazard Tree Removal Project on approximately 250 acres along forest road 4S81. The majority of hazard trees proposed for removal occur in high severity burned areas; however, hazard trees within mixed severity burned areas are also included to ensure the safety of road users in all those areas where burned trees pose a genuine risk of falling into the roadway. These activities would have minimal effect on goshawk habitat in the analysis area.

As with other species, the SNFPA (USDA 2001) provided our analysis of Northern goshawks with useful historical and habitat information. Evidence suggests the low number of breeding territories (ranging from 12 reported in the SNFPA (USDA 2001) to the 57 such territories known to exist today) has increased since some of the earliest data were reported by Grinnell and Miller

(1944 – as cited in USDA 2001), because there has been no apparent change in the geographic distribution of Northern goshawks in the Sierra Nevada since then. Thus, goshawk numbers in the SNF remain fairly stable. Reasons for this, as put forth by the SNFPA (USDA 2001), include: 1) vegetation management practices, 2) the fact that the SNF is near the southernmost edge of the goshawk range and 3) survey efforts for goshawks may be lower on the SNF.

While there are short-term effects (loss of snags and down woody material), the horizontal and vertical diversity of forest vegetation structure and species would be improved over time. Snags presently are, and would continue to be deficient in burned early-seral plantations (plantations prior to the fire) that are replanted; however the limited extent of the proposed salvage actions does not diminish the number of snags that are needed by this species across the landscape. Down wood would also increase over time, continuing to contribute to large logs on the landscape as snags fall and trees get older and die. Overall, alternatives, especially alternative 2 do not have a substantial cumulative impact to northern goshawks or their habitats, when considering past, present, and foreseeable future actions. This conclusion is particularly evident when considering that a majority of the burned area would not be treated, that the treatments only remove dead trees and the actions would only occur during a limited temporal period.

Pallid Bat and Fringed Myotis

Pallid bat is considered a Mammal Species of Special Concern by California Department of Fish and Game, and a Sensitive Species by both Region 5 of the U.S. Forest Service and BLM. The Western Bat Working Group (WBWG) designated it as a high priority for conservation measures for most of its range in California.

Pallid bats are distributed throughout much of the west, from southern British Columbia to central Mexico, and as far east as western portions of Kansas, Oklahoma, and Texas, with an isolated subspecies in Cuba (Hermanson and O'Shea 1983; Simmons 2005). Pallid bat is primarily a low to mid-elevation species. In California it is found from sea level up to approximately 2,250 m (7,400') (Baker et al. 2008, Pierson et al. 2001), although it is most commonly found below 1,800 m (5,900') (Barbour and Davis 1969, Orr 1954, Pierson et al. 2001). It is found along the coast, in the coast ranges, the Central Valley, up to mid-elevation in the Sierra Nevada and Cascade ranges, and in the more xeric and desert habitats east of the Sierra Nevada and in southern California.

The fringed myotis occurs from southern British Columbia, Canada south to Veracruz and Chiapas, Mexico and from Santa Cruz Island, California east to the Black Hills of Wyoming and South Dakota. (O'Farrell and Studier 1980; Bradley, Post, and Weller 2005). It occurs throughout the Forest Service Region 5, except for the Central Valley and Colorado and Mohave deserts, however the species is patchily distributed showing irregular patterns of abundance (Bradley et al. 2007; CA Dept. of Fish and Game 2005). Although this species has wide distribution, it is considered rare, but may be common locally (CA Dept. Fish and Game 2005). The fringed myotis is known to migrate, but little is known about the distance traveled or location of winter habitats (O'Farrell and Studier 1973).

The fringed myotis is known to roost in caves, mines, buildings, crevices in rocks, and snags (O'Farrell and Studier 1973; Davis and Hitchcock 1965). Males are thought to roost singly or in small groups. In Douglas fir forests of northern California, fringed myotis day roosts were found exclusively in snags of early to medium stages of decay (Weller and Zabel 2001). Roost sites were characterized by having more snags ≥12 inches diameter at breast height, less canopy cover, and were closer to streams than random sites (Weller and Zabel 2001). Roost snags were taller

and larger in diameter, than random snags and other snags near the roost (Weller and Zabel 2001).

Occurrence in the Project Area

Surveys conducted in the Project area in 2014 (prior to the French Fire) have not detected pallid bats, however the Project area is within the range for this species and therefore the species could be present in the area. Hibernation and maternity colonies are not known, and not expected, in the Project area because of the lack of suitable habitat, such as caves, abandoned mines, buildings or major bridges. If present in the Project area, the pallid bat most likely would be found in small numbers and in localized areas using forage and roost habitats.

Surveys conducted in 2014 (prior to the French Fire) detected a single fringed myotis in the Project area at Rock Creek campground. Hibernation and maternity colonies are not known and not expected in the Project area because of the lack of suitable habitat, such as caves, abandoned mines, buildings or major bridges. Within the Project area the fringed myotis most likely would be found in small numbers and in localized areas using forage and roost habitats.

Bat foraging habitat is not limiting in the Project area, therefore, for this analysis, we have focused on assessing the availability of roosting habitat, as well as the potential effects of treatments to that habitat. Pallid bat and fringed myotis tend to prefer hardwood forests and hardwood-conifer forests, as well as other live tree and snag habitats that have roosting habitat features. Therefore, for this analysis, we considered all burned and unburned mature forests, trees and snags (>24 inches dbh or CWHR 5 and 6 classification) as a potential sources of pallid bat and fringed myotis roosting habitat.

Environmental Consequences

3.9.13. Alternative 1 – (No Action)

Direct and Indirect Effects

The No Action alternative would have no direct impacts to the pallid bat and fringed myotis bat because no management actions would be taken. However, this alternative also would indirectly affect the ecosystem and habitat conditions of the Project area, such as providing a substantial amount of standing and downed dead wood for potential fires; particularly when considering the current and projected increased temperature and drought conditions resulting from climate change.

This no action alternative also would not include tree planting. The lack of tree planting, especially in the areas with high/moderate burns, combined with higher annual temperature and drought, could greatly delay the development of mature forests, and possibly prompt some sites to become dominated by non-forest habitats for decades.

3.9.14. Alternative 2 – (Proposed Action)

Direct and Indirect Effects

We do not expect substantial direct impacts to these species resulting from alternative 2, such as cutting trees, yarding trees, and transporting trees by roads. If these species are present during the potential project activities, we anticipate that the individuals would move from the vicinity of

activity and shift to other suitable habitat in the nearby forest environment. Some incidental direct effects may occur to a few individuals; however, we do not anticipate significant adverse effects to the population as a whole.

Table 42. CWHR Habitat types Selected for Analysis

Abbreviation	CWHR Habitats	CWHR Specific High and Moderate Capability Size, Canopy Cover, and Substrate Classes
MHC	Montane Hardwood-Conifer	5M, 5D, 6
MHW	Montane Hardwood	5M, 5D
PPN	Ponderosa Pine	5M, 5D
SMC	Sierra Mixed Conifer	5M, 5D, 6
RFR	Red Fir	5M, 5D, 6
WFR	White Fir	5M, 5D, 6
JPN	Jeffrey Pine	5M, 5D, 6

Prior to the French Fire, there were 399 acres (3% of the Project area) of late seral closed canopy coniferous forest habitat within the Project area. 137 acres experienced high mortality (>50% basal area mortality) and 262 acres experienced moderate/low mortality. The high and moderate fire mortality burns created a deforested condition; however, thousands of fire-burned snags remain for potential roosting habitat. In contrast, forests burned at low or very low mortality generally contain key mature forest habitat features.

Alternative 2includes reforestation of conifers to promote the reestablishment and development of a mature conifer forest. Specifically, the action alternatives would include reforestation of up to 3,000 acres with locally gathered ponderosa pine, sugar pine, and incense cedar seedlings. It is unclear whether conifer plantations less than about 80 years old would benefit fringed-tail Myotis; however, plantations, or naturally regenerated forests, older than approximately 80 years are expected to provide potential new roosting habitat, as trees develop in size and potential structural cavities develop.

As stated by Brown 2002, as cited in USDA Forest Service 2005, the pallid bat and fringe-tailed Myotis appears to be negatively influenced by a reduction of maternity colonies, however any such colonies are not known on the forest, and structures that could be used for this purpose are typically retained.

Under alternative 2, just over half of the acres of late-seral closed canopy coniferous forest habitat are proposed for treatment. A small percent (3 percent) of the analysis area is comprised of late-seral closed canopy coniferous forest habitat (399 acres) and approximately 54% (216 acres) is proposed for treatment including: 116 acres within the roadside hazard treatment areas, 7 acres in plantations, 92 acres in first and second entry salvage, and 1 acre in DFPZ. Alternative 2includes reforestation of conifers to promote the reestablishment and development of early-seral coniferous forest, which may eventually develop into late-seral closed canopy coniferous forest.

Reforestation is particularly important to restore habitat across vast acreages that burned at high severity where there is little to no conifer seed source remaining.

Considering the current weighted average of snags across the French landscape is 24.9 snags/acre, and the projected weighted average for snags retained is 16.4 snags/acre, there would be a reduction of 8 snags/acre across the landscape. This does not appear to be a major reduction in snags across the landscape. Some or many of these snags could potentially provide suitable roosting habitat for the pallid bat and fringed myotis.

3.9.15. Alternative 3 – (No Herbicide)

Direct and Indirect Effects

Alternative 3 consists of the same treatments as defined by Alternative 2 except that the chemical methods of site preparation are replaced with a combination of hand and mechanical methods. The direct and indirect effects to late-seral closed canopy conifer habitat are similar as described under Alternative 2. Under this alternative no herbicide (glyphosate) would be used to treat noxious weeds or reduce competing vegetation (e.g. bearclover) from conifer plantations. This would lead to substantially lower success of reforestation, which could lead to an increase in chaparral/shrubland habitat across the Project area and potentially a decrease in the amount of late-seral closed canopy conifer habitat in the future. The use of hand and mechanical methods for treating competing vegetation is not expected to result in significant effects to the pallid bat or the fringed myotis populations or their habitat.

3.9.16. Alternative 4 – (Hazard Tree and Plantation Salvage Only)

Direct and Indirect Effects

Under this alternative, less than half of the acres of late-seral closed canopy coniferous forest habitat are proposed for treatment. A small percent (3 percent) of the analysis area is comprised of late-seral closed canopy coniferous forest habitat (399 acres) and approximately 45% (179 acres) is proposed for treatment including: 166 acres within the roadside hazard treatment areas, 9 acres in plantations, and 3 acres in DFPZ. The direct and indirect effects would be similar to those discussed under Alternative 2, except that fewer acres would be treated and reforested, potentially leading to less late-seral closed canopy conifer habitat in the future as compared to Alternative 2. Alternative 4 would retain 21.4 snags/acre across the landscape since treatments would only occur along roadsides and within existing plantations.

3.9.17. Alternative 5 – (No Secondary Entry)

Direct and Indirect Effects

Under this alternative, just over half of the acres of late-seral closed canopy coniferous forest habitat are proposed for treatment. A small percent (3 percent) of the analysis area is comprised of late-seral closed canopy coniferous forest habitat (399 acres) and approximately 54% (214 acres) is proposed for treatment including: 135 acres within the roadside hazard treatment areas, 10 acres in plantations, 68 acres in first entry salvage, and 1 acre in DFPZ. The direct and indirect effects would be similar to those discussed under Alternative 2. Alternative 5 would retain 17.8 snags/acre since treatments would not occur in the areas proposed for secondary salvage.

Cumulative Effects

See the cumulative effects table (Appendix E) which lists the current and future actions that have or would have relevant effects on the environment of this species and its habitat. Actions that typically have had the greatest effects on habitats of this species include forest restoration thinning and mastication work, hazard tree removals, prescribed burning and forest restoration.

BLRD is currently implementing the Mile High Roadside Hazard Tree Removal Project on approximately 250 acres along forest road 4S81. This road is a National scenic byway which traverses through the center of the French Fire. The majority of hazard trees proposed for removal occur in high severity burned areas; however, hazard trees within mixed severity burned areas would also be included to ensure the safety of road users in all those areas where burned trees pose a genuine risk of falling into the roadway. These activities would have minimal effect on bat habitat in the analysis area.

Overall, the environmental condition of the analysis area, including past, present and foreseeable actions, provides thousands of acres of suitable habitat for the pallid bat and fringed myotis bat species. Our current and future management goals and directions also are expected to result in ecosystem integrity and long-term forest sustainability for the national forest as a whole. This management includes retaining and developing older and larger trees and snags across the SNF landscape, which would provide roosting habitat for these bat species.

Actions proposed in the alternatives are not expected to create adverse impacts to the pallid bat and fringed myotis when considering this environmental condition, including the effects of past, present and foreseeable future actions. The actions of these alternatives could have some incremental or cumulative effects on the environment, however we do to not anticipate those effects would result in a considerable net of negative impacts to the pallid bat and fringed Myotis populations or their habitats. Minimal effects from snag removal occurring from the Mile High hazard project and the proposed alternatives of the French Project would lead to a reduction in potentially suitable roosting habitat for these species, however when compared to pre-fire conditions, the level of snag roosting habitat that would be maintained across the landscape has increased dramatically. Therefore, although some potential roost trees may be removed by project activities, there would be an increase in suitable habitat compared to pre-fire conditions. In summary, we do not foresee significant impacts to the pallid bat or the fringed myotis or their habitat as a result of cumulatively adding the alternative actions to the environmental condition.

Determinations

The BA/BE has determined that implementation of Alternative 1 **may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the California spotted owl, Northern goshawk, pallid bat, and fringed myotis** because stands which burned in the high/moderate mortality category would remain untreated which in turn would not be habitat in the foreseeable future for these species. Spotted owl, goshawk and bats may use some of the areas for foraging but the majority would not be suitable nesting or roosting habitat (dense coniferous forest) in the foreseeable future.

Indirect effects of no action include the potential for future wildfire and its impact on habitat development and recovery. The fuel loads that would be left by this alternative would make future wildfires in the area difficult to suppress and create a more intense burn, which could lead to increased rates of spread resulting in potential loss of suitable owl, goshawk, and bat habitat and other important habitat attributes such as large trees, large snags, and down woody material.

The occurrence of another large fire within the analysis area would further fragment owl and goshawk habitat and could cause vegetation type conversions from coniferous forest to chaparral/brush.

The BA/BE has determined that implementation of an action alternative, 2-5 **may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the California spotted owl, Northern goshawk, Pallid bat, and fringed myotis** because suitable fire-affected owl, goshawk and bat habitat occurs within the project area, however the action alternatives would not result in substantial reductions of that habitat. The French project has designed measures to retain high quality habitat used for nesting and roosting, as well as burned habitat that these species may use for foraging. All live trees that are not a hazard tree would be retained. Sufficient levels of large snags ≥15”dbh that provide potential nest and roost sites, would be maintained, even under the most aggressive action alternative. Sufficient levels of large woody debris would be retained throughout treatment areas. This project does not propose to remove any oaks unless they are a hazard tree, and measures would be implemented to protect black oaks. A few individual spotted owls, goshawks or bats may be disturbed by project activities, although this only would be for the short-term duration of those actions. Additionally, a Limited Operating Period would be implemented surrounding owl activity centers.

All action alternatives also may result in long-term positive effects to the spotted owl, goshawk and bats by: 1) reducing the potential for another future, uncharacteristically severe, stand eliminating wildfire; and 2) promoting the growth of conifer forest, which provides forage for prey species, as well as hiding and thermal cover. All of these factors combined outweigh the short-term negative effects of treatments (due to immediate partial loss of forest biomass and disturbance), especially considering that a more severe fire regime is predicted for the future, and without fuels reduction, large scale, stand replacing wildfires would most likely cause serious and substantial impacts to the populations.

Pacific Fisher

On October 7, 2014, the USFWS announced a proposal to list the West Coast DPS of fisher as threatened under the ESA (USFWS 2014). The fisher is also a candidate for listing under the California Endangered Species Act pursuant to a 2012 court order that forced the California Fish and Game Commission to set aside its 2010 findings that listing was not warranted (Center for Biological Diversity v. California Fish and Game Commission et al. 2012). The California Department of Fish and Wildlife (CDFW) is reviewing the fisher’s status in the state pursuant to the court order.

The southern Sierra Nevada provides habitat for the southernmost population of fishers. The small and isolated southern Sierra fisher population is estimated at <500 individuals, and monitoring indicates a stable population over the past decade (Zielinski et al. 2013). Some evidence of population expansion has been indicated as a result of systematic monitoring since the 1990’s (Tucker et al. 2014).

Habitat Use

A study implemented by Jones and Garton, *in* Buskirk et al. 1994, showed that fishers avoided openings and forested areas with 40% or less canopy cover (Jones 1991). Preferred resting habitat patches should therefore be linked by travel corridors of closed canopy forest. High connectivity of preferred habitats would allow the landscape to support such wide-ranging species as the fisher. Some evidence from the study area suggests that fishers preferred forested riparian areas

for resting sites and used them extensively for traveling. In addition forested riparian sites likely provide optimal habitat for two preferred prey in the study area: snowshoe hares and southern red-backed voles. Thus riparian forests would likely make excellent corridors to connect preferred habitats.

Fishers in the western United States are habitat specialists associated with mature and late-successional forests with an abundance of large trees, snags, and logs (greater than 39 in), conifers and oaks with broken tops and cavities, coarse woody-debris, multiple canopy layers, high canopy closure, and few openings (Aubry and Houston 1992; Buck *et al.* 1994; Buskirk and Powell 1994; Dark 1997; Freel 1991; Jones and Garton 1994; Powell and Zielinski 1994; Seglund 1995; Truex *et al.* 1998; Zielinski 1999). The fisher is among the most habitat-specific mammals in North America, and changes in the quality, quantity, and distribution of available habitat can affect their distributional range (Buskirk and Powell 1994). Forest type is probably not as important to fishers as the vegetative and structural aspects that lead to abundant prey populations and reduce their vulnerability to predation (Powell 1993). In general, fishers use forest or woodland landscape mosaics that include conifer-dominated stands, and avoid entering open areas that have no overstory or shrub cover (Buskirk and Powell 1994). They select forests that have low and closed canopies. Late-successional coniferous or mixed forests provide the most suitable fisher habitat because they provide abundant potential den sites and preferred prey species (Allen 1987).

Uncharacteristically Severe Wildfire: Uncharacteristically severe wildfire is defined as fire occurring beyond the historical range of natural variation in terms of scope, intensity and duration. These stand-replacing fires affect large areas of the landscape, decreasing or removing key fisher structural and habitat elements including large trees, overstory and understory canopy, vegetative diversity, snags, and logs. Habitat connectivity across the landscape for fisher movements at all scales may decrease as a result. As part of the threat evaluation completed for the West Coast Fisher Conservation Assessment (Lofroth et al. 2010), uncharacteristically severe wildfire ranked as a high threat in the southern Sierra Nevada geographic area.

Fragmented landscapes created by uncharacteristically severe wildfires eliminate fisher habitat linkages, either permanently via vegetative type conversion or temporarily until recovery occurs. Habitat connectivity across the landscape for fishers is decreased. This results in detrimental impacts to fisher daily movements and energy balance, creates barriers to dispersal movements, affects the establishment of home ranges, and prolongs or prevents breeding season movements. These impacts may decrease fisher survival. Overall population fitness is affected by individual survival and mortality. Direct mortality as a result of fire may occur in extreme cases depending upon season (e.g. kit loss in reproductive season, loss of adults in fast-moving canopy firestorms).

Following wildfire, prey species abundance and community composition shifts. An initial increase in abundance of disturbance-adapted prey species may occur at the expense of species diversity with a gradual reversal of this trend as succession occurs. Although prey abundance may increase, prey availability would not necessarily follow due to fisher reluctance to enter open areas. Extensive burned areas can create dispersal barriers for prey. The West Coast Fisher Biology Team speculated that the abundance of prey available following fire may support pre-fire population levels of fishers that have been compressed into adjusted home ranges. This prey abundance may not persist over time, however, and result in displacement or loss of fishers on the margins of remaining habitat (Macfarlane, pers. comm.). Displaced individuals could create conspecific competition if packed into the remaining habitat, which could, in turn, increase disease transmission.

Fishers exhibit strong selection for rest and den sites based upon forest structure and canopy cover. Changes in the frequency, abundance, and distribution of these habitat elements may create conditions that are unfavorable to successful reproduction, as well as survival of the young to recruitment into the population. Due to the lack of well-distributed escape cover results in increased predation.

Habitat Fragmentation or Loss of Connectivity

Habitat connectivity is a key to maintaining fisher within a landscape. Activities under Forest Service control that result in habitat fragmentation or population isolation pose a risk to the persistence of fishers. Timber harvest, fuels reduction treatments, road presence and construction, and recreational activities may result in the loss of habitat connectivity resulting in a negative impact on fisher distribution and abundance. The French and Aspen Fires disrupted fisher connectivity across the San Joaquin River south of Mammoth Pool reservoir.

Fisher Use of Burned Habitat

A recent study by Hanson (2013) examined fisher habitat use throughout a large mixed severity burned landscape located on the Kern Plateau in the Sequoia National Forest. The investigation was conducted 3 to 10 years post-fire, which had allowed for some level of vegetative recovery. In this study, scat detector dogs were used to determine presence of fisher across the burned and unburned landscape. Hanson (2013) asserts that fisher selected pre-fire mature/old forest that experienced moderate/high-severity fire more than expected based upon availability, just as fishers are selecting dense, mature/old forest in its unburned state. Hanson (2013) further noted that when fishers were near fire perimeters, they strongly selected the burned side of the fire edge.

While this study reports valuable evidence of fisher not avoiding low severity burned landscape 3 to 10 years post fire, further conclusions are limited given the methodology and analysis used to interpret the results. For example, Hanson cites Miller et al. (2009) to define low, moderate, and high fire severity categories. However, the ranges of values used for each fire severity category identified in Miller et al. (2009) were adjusted by Hanson (2013) for his analysis of data. Due to the adjustment of the definitions and the subsequent combining of moderate and higher-severity fire in Hanson's (2013) analysis, no conclusions can be drawn concerning the effects of moderate or severe fires on fisher habitat use (Spencer et al. 2015). From inspection of fire history maps and figure 1 in Hanson (2013), it appears that most fisher scats were found in unburned or lightly burned areas, and that scats inside fire perimeters were mostly near edges rather than fire interiors. Survey transects did not adequately sample large areas burned at moderate to high-severity to draw any conclusions about their use by fishers. It is also problematic to conclude that fisher used pre-fire mature/old forest that experienced moderate/high severity fire more than expected based upon availability when a statistically non-significant result was reported by Hanson (2013) in Table 2a. Precisely how the McNally fire and other fires on the Kern Plateau have affected fisher occupancy and abundance is unknown and deserving of more study; however, the regional occupancy results indicate that fishers have persisted in a landscape that has experienced a mosaic of low to high severity fires, albeit with the lowest recorded occupancy rates in the assessment area (Zielinski et al. 2013a).

USFS policy recognizes the ecological importance of low/moderate mixed severity fire regimes in Sierran mixed conifer forests in that they provide regeneration and habitat for numerous species. Hanson's (2013) study, which confirms fisher use of low (and perhaps low-moderate) severity post burn fire areas further supports this policy. However large scale uncharacteristically severe wildfire poses a risk to fisher denning and resting habitat, as well as habitat connectivity

(Lofroth et al. 2010). While Hanson (2013) provides a starting point to begin to understand how fishers use post fire landscapes as they recover, further research is necessary to evaluate the use of moderate and high severity post fire landscapes by fisher as well as use of large contiguous burned areas and burned areas immediately following fire.

Occurrence in the Project Area

On the Bass Lake Ranger District there have been 56 den buffers delineated surrounding known fisher den sites from 2008-2013. This data is based on the survey efforts from the Sierra Nevada Adaptive Management Project (SNAMP) UC Berkeley fisher crew (2008-2012) and since 2012 from the Pacific Southwest Research Station (USFS-PSW) who inherited the SNAMP fisher project in 2012. Of that total, there were only four historic den buffers (2010-2013) in or within the vicinity of the French Fire and those were on the western edge of the French Fire (Figure 1). As of 2014, post-fire, there were no collared fishers in or within approximately 0.25 miles of the French Fire perimeter.

Fisher Linkage Area D

The Southern Sierra Fisher Conservation Assessment (Spencer et al 2015) identified population cores and key linkage areas throughout the range of the Southern Sierra fisher population. Linkage “D” connects population cores 4 and 5 across the San Joaquin River. The Conservation Biology Institute (CBI) has performed connectivity modeling which indicates the most likely crossing place for fisher is at or below the Mammoth Pool dam. This is consistent with observations made by the SNAMP fisher project (R. Sweitzer personal communication). The 2013 Aspen fire and 2014 French Fire burned much of the potential fisher dispersal habitat on the east and west sides of the San Joaquin River below Mammoth Pool reservoir reducing the dispersal potential between cores 4 and 5 (Spencer et al 2015). “Large contiguous areas of severe fire can result in the long-term replacement of conifer forest by shrubs, which are maintained by subsequent fires (Wilken 1967, Biswell 1974, Bock and Bock 1977)” *In* (Spencer et al. 2015).

For the Project area, Alternatives 2, 3 (although slower), and 5 would reforest substantially more dispersal habitat within the linkage area when compared to Alternative 4. Alternative 4 would only treat areas within existing plantations and along roadsides.

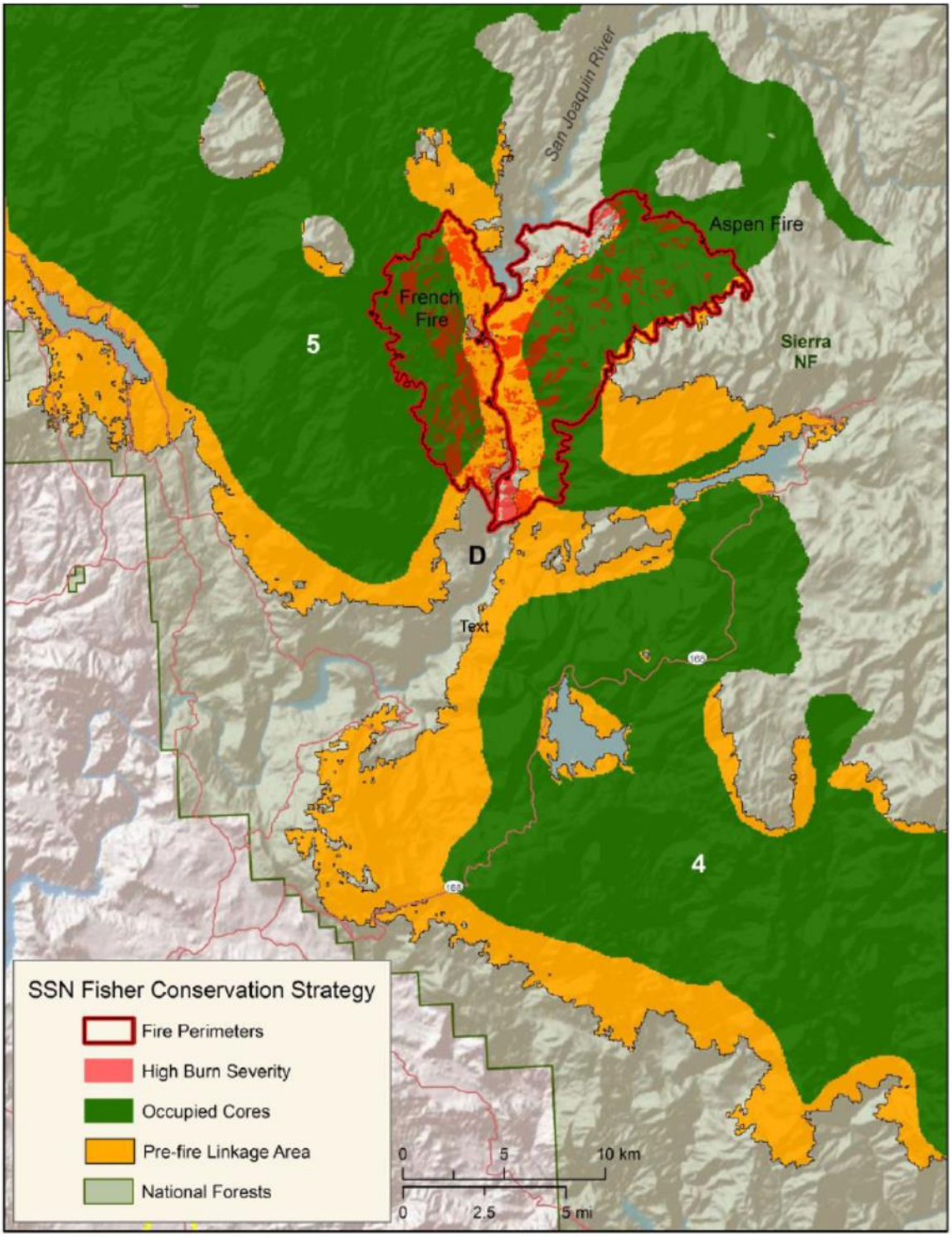

Figure 24. The2013 Aspen Fire and 2014 French Fire in Linkage D and Cores 4 and 5 showing severely burned patches (RAVG >75% BA loss) From Spencer et al 2015 (Figure 19).

Environmental Consequences

Limited Operating Period

To limit the potential for disturbance to denning fishers and their kits, a LOP would be in effect from March 1 through June 30, prohibiting intensive mechanical activities (such as commercial-sized timber harvest) during the time period when female fishers are most vulnerable to disturbance. Less invasive activities that are limited in scope and duration such as post-harvest slash piling and burning, string trimming of invasive weeds, herbicide application, hand-thinning of biomass trees <10" dbh, and conifer planting may occur during the LOP. The LOP would be applied to all action alternatives.

CWHR 2.1

The following CWHR types are important to fishers: generally structure classes 4M, 4D, 5M, 5D and 6 (stands with trees 11" diameter at breast height or greater and greater than 40% cover) in ponderosa pine, montane hardwood-conifer, Klamath mixed-conifer, Douglas-fir, mixed conifer, montane riparian, aspen, redwood, red fir, Jeffrey pine, lodgepole pine, subalpine conifer, and eastside pine (Timossi 1990). CWHR assigns habitat values according to expert panel ratings. CWHR2 is a derivative of the CWHR fisher habitat relationship model constructed by Davis et al. (2007). They used best available science to revise the statewide model and eliminate some forest types that appeared to contribute little to fisher habitat: aspen, eastside pine, lodgepole pine, montane riparian, red fir, and subalpine conifer. We have further refined CWHR2 to reflect only those forest types present in the southern Sierra Nevada: Jeffrey pine, montane hardwood-conifer, montane hardwood, Ponderosa pine, Sierran mixed-conifer and white fir, terming it CWHR2.1 (Table44).

Table 43. CWHR2.1 high and moderate capability habitat for Pacific fisher

CWHR Abbreviations	CWHR2.1 Habitats	CWHR2.1 High and Moderate Capability Size, Canopy Cover, and Substrate Cover
JPN	Jeffrey Pine	4P, 4M, 4D, 5M, 5D
MHC	Montane Hardwood-Conifer	4P, 4M, 4D, 5S, 5P, 5M, 5D, 6
MHW	Montane Hardwood	4P, 4M, 4D, 5S, 5P, 5M, 5D, 6
PPN	Ponderosa Pine	4P, 4M, 4D, 5P, 5M, 5D
SMC	Sierran Mixed Conifer	4P, 4M, 4D, 5S, 5P, 5M, 5D, 6
WFR	White Fir	4P, 4M, 4D, 5S, 5P, 5M, 5D, 6

The Project ranges in elevation from 2,400 to 7,000 feet in elevation; the fisher ranges in elevation from 3,500 to 8,000 and the denning habitat occurs up to 6,500 feet in elevation (C. Thompson, pers comm.). Of the six CWHR types for fisher listed in Table 44, four types occur in the Project area (Table 45). Prior to the fire there were 9,934 acres of suitable habitat of the 13,830 total acres within the French Fire boundary. Over half of the suitable habitat (52%) burned

at high and moderate severity with >50% basal area mortality. These 5,175 acres are no longer considered suitable fisher habitat, and the burn pattern could disrupt fisher population connectivity across the San Joaquin River in the key Linkage Area "D" (Figure24).

Table 44. Suitable CWHR 2.1 fisher habitat within French Fire displayed with post-fire basal area mortality effects

Before French Fire			French Fire Mortality Effects			
CWHR type	Acres	Percent of total fire area (13,830 ac)	Moderate/Low <50% BA Mortality		High >50% BA Mortality	
			Acres	Percent	Acres	Percent
MHC	2,829	20%	1,335	47%	1,494	53%
MHW	3,020	22%	1,328	44%	1,692	56%
PPN	1,979	14%	954	48%	1,025	52%
SMC	2,106	15%	1,142	54%	964	46%
Total	**9,934**	**71%**	**4,760**	**48%**	**5,175**	**52%**

3.9.18. Alternative 1 – (No Action)

Direct and Indirect Effects

Under the No Action alternative the Project area would not be treated. No direct effects would occur to the fisher because no additional action would take place. The greatest impact to the fisher or fisher habitat within the analysis area has resulted from the French Fire. Those portions of the analysis area that burned at high and moderate severity and no longer provide suitable fisher habitat may remain unsuitable for fisher denning for the next 100-150 years under this alternative (Smith 2015). "Large contiguous areas of severe fire can result in the long-term replacement of conifer forest by shrubs, which are maintained by subsequent fires (Wilken 1967, Biswell 1974, Bock and Bock 1977)" *In* (Spencer et al. 2015). Approximately 52% (5,175 acres) of suitable denning and foraging habitat, within the high/moderate conifer mortality category, was lost during the French Fire. Connectivity between Fisher Core populations 4 and 5 may be substantially compromised by the level of high severity fire impacts to vegetation within the key linkage area "D". Intraspecific competition for suitable denning and foraging habitat outside the burn area also may increase as fire-displaced fisher from within the burn disperse in search of suitable habitat.

Indirect effects of no action include the potential for future wildfire and its impact on habitat development and recovery. The fuel loads that would be left by this alternative would make potential wildfires in the area difficult to suppress and create a more intense burn, which could lead to increased rates of spread resulting in potential loss of suitable fisher habitat and other important attributes such as large trees, large snags, and down woody material (Stalter 2015). The occurrence of another large fire within the analysis area would further fragment fisher habitat and could cause vegetation type conversions from coniferous forest to chaparral/brush.

3.9.19. Alternative 2 –(Proposed Action)

Direct and Indirect Effects

A total of 9,934 acres of pre-fire suitable fisher habitat existed in the project area (Table 46). The majority of suitable habitat experienced high severity fire effects, has a canopy cover of 3-7%, and is no longer considered suitable habitat. Fisher may move through the area; however, the high/moderate areas burn areas would not be utilized for resting or denning because the canopy cover and brush/understory component is no longer present, which in-turn is not considered fisher habitat, as defined by CWHR classification.

Table 45. Summary of Proposed Action Treatment Acres by fisher habitat type and burn severity

CWHR type	Total Acres in Project	No Treatment		Acres Proposed for Treatment by Mortality Class			
				Moderate/Low <50% BA mortality		High >50% BA mortality	
		Acres	Percent	Acres	Percent	Acres	Percent
MHC	2,829	1,345	48%	640	23%	845	29%
MHW	3,020	2,083	69%	364	12%	574	19%
PPN	1,979	907	46%	506	26%	567	28%
SMC	2,106	903	43%	552	26%	653	31%
Total	**9,934**	**5,238**	**53%**	**2,062**	**21%**	**2,639**	**26%**

A total of 2,062 acres of marginally suitable fire-affected (0-50% Basal area mortality) fisher habitat are proposed to be treated under alternative 2. Most of these acres (1,193 acres) are in the roadside hazard buffer, which proposes to remove hazard trees within a 300 foot buffer along approximately 64 miles of roadsides within the Project boundary. The remaining acres are within first entry units (268 acres), secondary entry units (366 acres), plantations (182 acres) and powerline/DFPZ treatment areas (50 acres).

Dead or dying trees can provide resting and denning habitat for fisher when they are located within dense stands of live trees. Analysis of snag habitat shows that there will more than 90,500 large conifer snags (> 15 inches dbh) retained in the low and moderate mortality areas (<50% BA loss) after the alternative 2 treatments have been implemented (Table 33). This amount consists of all large snags retained in untreated areas, as well as an average of four snags per acre retained in treated areas according to the design criteria. Within treated areas, snags are proposed for retention along perennial streams and are co-located with green forest where possible to increase the likelihood that fishers would select these legacy structures in the near future.

Some treatments would occur in portions of two historic (2012) fisher den buffers that burned at high severity where the habitat has been rendered unsuitable. No treatments would occur within

250 meters of a historic den tree. The areas that have been identified for treatment are primarily in the >90% basal area mortality range. For further protection from potential disturbance, an LOP would be in effect limiting timber harvest during the time period when fisher would be denning (March 1 –June 30). This LOP would eliminate or substantially minimize the potential for direct impacts. These areas would be reforested with a combination of native, locally sourced ponderosa pine, sugar pine, and incense cedar to promote recovery of fisher habitat in the near future.

Removal of roadside hazard trees within the lower severity fire areas could remove a potential den or rest tree, however local research has shown that fishers had limited use of the area prior to the French Fire, and use is expected to be lower post-fire. It is not known whether fisher would select or benefit by the presence of the large abundance of snags in the French Fire. However, the fact that the Project area would retain thousands of potential rest and den sites across the Project area is of benefit to the species.

3.9.20. Alternative 3 –(No Herbicide)

Direct and Indirect Effects

Alternative 3 consists of the same treatments as defined by Alternative 2; however, chemical methods of site preparation and noxious weed eradication are replaced with a combination of hand and mechanical methods. Planting strategies would occur as described in alternative 2 and release treatments are limited to hand and mechanical methods. Hand and mechanical methods would be used to meet the objective of retaining less than 20% brush cover on moderate and high productivity sites and less than 15% on low productivity sites. The potential direct effects would be the same as discussed under Alternative 2. Indirect effects to habitat recovery time may be an issue without the use of herbicides to control competing vegetation such as bear clover and manzanita within areas proposed for conifer reforestation. Ponderosa pine seedling survival can be as low as 20% when competing with bear clover. Additionally, this competition can cause as much as a 75% reduction in growth of ponderosa seedlings. It is likely that the reforestation under this alternative would be far less successful when compared to Alternative 2 (Smith, 2015).

3.9.21. Alternative 4 –(Hazard Tree and Plantation Salvage Only)

Direct and Indirect Effects

Alternative 4 would only treat roadside hazards (2,842 acres), existing plantations (252 acres), and DFPZ/powerline areas (187 acres) and no treatment would occur on 6,652 acres of CWHR 2.1 pre-fire fisher habitat (Table 46).

Table 46. Summary of Alternative 4 Treatment Acres by fisher habitat type and burn severity

CWHR type	Total Acres in Project	No Treatment		Acres Proposed for Treatment by Mortality Class			
				Moderate/Low <50% BA mortality		High >50% BA mortality	
		Acres	Percent	Acres	Percent	Acres	Percent
MHC	2,829	1,825	65%	520	18%	484	17%
MHW	3,020	2,325	77%	316	10%	378	13%
PPN	1,979	1,199	61%	433	22%	347	18%
SMC	2,106	1,303	62%	442	21%	361	17%
Total	**9,934**	**6,652**	**67%**	**1,711**	**17%**	**1,570**	**16%**

A total of 1,711 acres of marginally suitable fire-affected (0-50% basal area mortality) fisher habitat are proposed to be treated under Alternative 4. Most of these acres (1,516 acres) are in the roadside hazard buffer, which proposes to remove hazard trees within a 300 foot buffer along approximately 64 miles of roadsides within the Project boundary. The remaining acres are within plantations (133 acres) and powerline/DFPZ treatment areas (62 acres).

Alternative 4 would treat 351 fewer acres of marginally suitable fisher habitat when compared to Alternative 2 because no first or secondary treatment areas would be treated. Most of the first and secondary entry treatments proposed in Alternative 2 overlap with roadside hazard treatments, which is one reason why the actual treated acres is not very different between these two alternatives. The other reason is that Alternative 2 would primarily treat areas that burned at high fire severity and are no longer considered suitable fisher habitat. Less of the key linkage area “D” between fisher core populations 4 and 5 would be treated and reforested under this alternative, which could lead to a more fragmented population.

Some roadside hazard and plantation treatments would occur in portions of two historic (2012) fisher den buffers that burned at high severity where the habitat has been rendered unsuitable. No treatments would occur within 250 meters of a historic den tree. The areas that have been identified for treatment are primarily in the >90% basal area mortality range. An LOP would be in effect limiting timber harvest during the time period when fisher would be denning (March 1 – June 30) to limit the potential for disturbance. These areas would be reforested with a combination of native, locally sourced ponderosa pine, sugar pine, and incense cedar to promote recovery of fisher habitat in the near future.

Removal of roadside hazard trees within the lower severity fire areas could remove a potential den or rest tree, however local research has shown that fishers had limited use of the area prior to the French Fire, and use is expected to be lower post-fire. It is not known whether fisher would select or benefit by the presence of the large abundance of snags in the French Fire. However, the

fact that the Project area will retain thousands of potential rest and den sites across the Project area is of benefit to the species.

3.9.22. Alternative 5 – (No Secondary Entry)

Direct and Indirect Effects

Alternative 5 is similar to the proposed action except that secondary salvage areas (910 acres) are not proposed for treatment and subsequent reforestation.

Table 47. Summary of Alternative 5 Treatment Acres by fisher habitat type and burn severity

CWHR type	Total Acres in Project	No Treatment		Acres Proposed for Treatment by Mortality Class			
				Moderate/Low <50% BA mortality		High >50% BA mortality	
		Acres	Percent	Acres	Percent	Acres	Percent
MHC	2,829	1,506	53%	567	20%	757	27%
MHW	3,020	2,173	72%	330	11%	518	17%
PPN	1,979	990	50%	465	23%	524	26%
SMC	2,106	967	46%	520	25%	619	29%
Total	**9,934**	**5,636**	**57%**	**1,882**	**19%**	**2,418**	**24%**

A total of 1,882 acres of marginally suitable fire-affected (0-50% basal area mortality) fisher habitat are proposed to be treated under Alternative 5. Most of these acres (1,379 acres) are in the roadside hazard buffer, which proposes to remove hazard trees within a 300 foot buffer along approximately 64 miles of roadsides within the project boundary. The remaining acres are within first entry treatments (255 acres) plantations (193 acres) and powerline/DFPZ treatment areas (55 acres).

Alternative 5 would treat 180 fewer acres of marginally suitable fisher habitat when compared to Alternative 2 because no secondary treatment areas would be treated. Most of the secondary entry treatments proposed in Alternative 2 overlap with roadside hazard treatments, which is one reason why the actual treated acres is not very different between these two alternatives. The other reason is that Alternative 2 would primarily treat areas that burned at high fire severity and are no longer considered suitable fisher habitat. Slightly less of the key linkage area “D” between fisher core populations 4 and 5 would be treated and reforested under this alternative, which could lead to a more fragmented population.

Cumulative Effects

The estimated cumulative effects of the Project on fisher habitat were compared to the total available fisher habitat within the following five scales of geographic areas, spanning from the local Project level (Level 1) to the regional level (Level 5). The geographic boundaries of the cumulative effects analysis are displayed for levels 2 through 5 below. As fisher have large ranges evaluating cumulative effects within the Project boundaries is not useful and therefore Level 1 will not be evaluated.

Level 1 = Fisher habitat within the Project boundary

Level 2 = Fisher habitat within the Project area plus the 3.1 mile buffer area

Level 3 = SNF wide

Level 4 = Southern Sierra Conservation Area (SSFCA)

Level 5 = Sierra Nevada Region

Level 2

Level 2 is the project plus a 3.1 mile buffer around the project area. The 3.1 mile project area buffer represents the area where an average female fisher home range (95% kernel home range of 4,735 acres) may overlap or touch the Project area. The average home range was derived from 27 radio collared female fishers studied from 2007-2009 in the Kings River Fisher Study Area of SNF. (Thompson et al. 2010). The intent of this method is to assess the potential effects of the project not only on fishers using the project area, but also on those that may have home ranges that overlap or border the Project area.

The assessment of **Level 2** shows there are 40,776 acres of suitable fisher habitat within the 3.1 mile buffer of the fisher area. The 3.1 mile buffer is made up of the following CWHR 2.1 habitat types (Table 49).

Table 48. CWHR 2.1 types within the 3.1 mile buffer, outside the French project boundary, for Level 2 analysis of fisher habitat

CWHR 2.1 Types	4D	4M	4P	5D	5M	5P	5S	Grand Total
JPN	17	7						24
MHC	1906	2737	103	568	271	38	73	5696
MHW	5161	698	1267	713	70	78	7	7995
PPN	2118	1453	275	2152	438	70	5	6510
RFR	31	156	177	69	69	12	9	523
SMC	4139	2608	624	11020	1366	191	81	20029
Grand Total	**13372**	**7660**	**2446**	**14521**	**2214**	**389**	**175**	**40776**

Other on-going vegetation management projects within the 3.1 mile buffer include the Whisky Ridge project on the Bass Lake Ranger District and the Aspen Fire Restoration Project on the High Sierra Ranger District. The Whisky Ridge project conducts fuels reduction treatments over the next 5-10 years to reduce the risk of uncharacteristically severe wildfire to fisher habitat on the Bass Lake Ranger District. A biological evaluation completed in 2013 documented minimal changes to fisher habitat (260 acres experienced a reduction in CWHR density) within that Project area.

As it relates to the **Level 2**, fisher dispersal data from Rick Sweitzer (pers. Comm. 2014), shows there was one male fisher that dispersed from Shaver Lake up to an area above Bass Lake in the Central Camp Area. The male stayed in the Central Camp area and has not been picked up since he dropped his collar and they are not trapping in that area currently. There was another fisher in the SNAMP project from a few years ago indicating that one fisher moved across the San Joaquin via Mammoth Pool dam, or just below the dam but then came back across to the Bass Lake Ranger District after about three weeks. CBI modeling (Spencer et al 2015) identifies the region at/near Mammoth Pool Dam as the most likely corridor for cross river movements by fishers. However, this corridor may have been compromised by the French and Aspen fire effects.

About 95,725 acres of private lands (15% of the Forest) (such as Southern California Edison, Pacific Gas and Electric and residential areas) occur within the Forest. These private lands are dispersed throughout oak woodland, shrubland and forested habitats, so it is reasonable to assume that only a small percent of each habitat has and will be impacted by activities on private lands.

Private land forestland management was taken into consideration with our cumulative effects assessments. This management may have some effects on fishers inhabiting that area, such as reducing potential den and rest sites with high canopy cover, as well as potentially producing greater understory vegetation species and abundance of herbaceous and shrub vegetation, which in-turn would increase habitat for many fisher prey species.

Appendix E lists the ongoing federal management activities on the Forest. These projects include the prescribed burn program, other fuel reduction projects, timber and culture projects, active cattle allotments, and recreational activities and events (e.g., off-highway vehicles [OHVs] and off-snow vehicles [OSVs]). All of these projects are predicted to ultimately result in greater long-term retention of fisher habitat within Project boundaries over the long term.

A majority of management occurring in fisher habitat on the HSRD is within the Dinkey Landscape Restoration Project Area. The BLRD of SNF currently has five land management projects of the size that could influence the cumulative effect on fisher habitat. Treatments have recently been completed or contracted for Sonny Meadows North (with 955 acres of treatments); Sonny Meadows South (with 1,400 or more acres of commercial thinning); Cedar Valley (with approximately 915 acres of commercial thinning); Sugar Pine (2,900 acres of fuel reduction prescriptions); Fish Camp (753 acres for thinning of which 400 acres are in plantations); and Grey's Mountain (3575 treated acres) (Table 25). These projects all have specific retention standards for canopy cover, snags, and large woody debris, as well as an LOP to reduce disturbance effects to fisher during the reproductive period. All of the projects are predicted to ultimately result in increase of the quality amount of fisher habitat within project boundaries over the long term.

Table 50 displays the recent vegetation management projects across SNF that have treatments within suitable fisher habitat. All of the vegetation management projects on both districts , within the fisher habitat elevational zone, typically retain an average minimum of approximately 50

percent overstory canopy cover immediately after treatment, and in most cases at a higher minimum level, such as 60% or greater, with canopy cover restoring to pre-treatment levels approximately 15 years post-treatment. The fact that all these projects provide for greater forest heterogeneity and understory vegetation abundance is a benefit to species that use this forest habitat, as well as reducing their susceptibility to wildfire, drought, insects, and disease, which help perpetuate these mature and old-age forest habitats on the landscape.

Table 49. Cumulative effects table showing the projects across the Forest along with the acres and percent fisher habitat being treated

SNF Treatments within Fisher Habitat - 2010 through 2015 – 6 yr. Period. [a]							
Project	**Year of Contract**	**Year When a Majority of Project is Implemented**	**Treated Area Acres [b]**	**Acres of Fisher Habitat (CWHR 2.1) in Treated Areas[c, e]**	**% of Total Habitat**	**Acres of >40% Fisher Probability (CBI) in Treated Areas [d, e]**	**% of Total Habitat**
Bass Lake Ranger District							
Sonny Meadows	2006	2010	701	640	0.4%	700	0.5%
Sugar Pine	2010	2012	1,115	996	0.6%	745	0.6%
Fish Camp	2011	2013	730	677	0.4%	568	0.4%
Greys Mt. 1	2012	2013	932	796	0.5%	917	0.7%
Greys Mt. 2	2013	2014	695	673	0.4%	685	0.5%
French Fire Restoration [g]	2015	2015	5,969	2,060	1.3%	3,887	2.9%
BLRD Subtotal			**10,142**	**5,842**	3.6%	**7,502**	5.7%
High Sierra Ranger District							
Dinkey North	2010	2011	878	749	0.4%	785	0.5%
Dinkey South	2010	2011	1,051	953	0.5%	952	0.6%
KREW (Prov. Unit)	2011	2012	505	452	0.3%	478	0.3%
Eastfork	2012	2013	1,198	870	0.5%	3	0.0%
Keola	2012	2013	305	219	01%	105	01%
Soaproot	2013	2014	807	652	0.4%	115	0.1%
Coyote	2013	2014	1,357	413	0.2%	566	0.3%
Aspen Salvage[f]	2014	2014	1,717	19	0.0%	37	0.0%
HSRD Subtotal			**7,818**	**4,327**	2.4%	**3,041**	1.8%
Total Project Acres - SNF			**17,960**	**10,169**	**3.0%**	**10,543**	**3.5%**

Total Habitat Bass Lake RD		**156,935**		**129,933**	
High Sierra RD		**179,590**		**170,568**	
Total Habitat-SNF		**336,525**		**300,501**	

Definition and Assumptions:
a. The CBI recommends a fuels reduction treatment rate of 4% to 8% every 5 years to benefit fisher (Spencer et al. 2008).
b. Column C – Current acreage from FACTS; future acreage was estimated.
c. Column D - Fisher habitat is defined as the CWHR 2.1 habitat between 3,000 and 8,000 feet elevation.
d. Column F - Fisher habitat is defined by the Conservation Biol. Inst. (CBI) (Spencer et al. 2008) as having >40% fisher probability.
e. The CWHR and CBI are two different methods for defining habitat, thus the reason for the differences in fisher habitat acreage.
f. Estimated based on amount within low and very low fire severity; moderate and high severity eliminated most canopy cover.
g. Estimated from all treatments proposed in CWHR 2.1 Habitat that burned at RAVG <50% Basal area loss

The SNF fuels reduction/forest restoration treatments provide net positive benefits to fisher habitat and populations by retaining and enhancing fisher habitat, including creating forests that are more resilient to large-scale, severe wildfires and drought. This is especially important when considering that the historical fire return interval (prior to the fire suppression era) within the primary fisher habitat (Sierran Mixed-Conifer Forests) averaged 7-12 years. Therefore, without periodic fuel reduction, these forests will become highly susceptible to large scale, high severity wildfire, and these types of fires are uncharacteristic compared to the historical low severity fires in which the fisher evolved. Large scale, high severity fires can greatly reduce mature and older aged forests, which are crucial for sustaining fisher and spotted owl populations. This management approach of reducing wildfire risk, while also retaining fisher habitat, has been shown to be an effective means for conserving fisher habitat and fisher populations over the long-term (Spencer et al. 2008; Scheller et al. 2011).

These fuels reduction/forest restoration treatments include individual tree thinning management (not large-scale clear-cutting) based on ecosystem management principles that retain and develop forest structure and biological integrity (*An Ecosystem Management Strategy for Sierran Mixed-Conifer Forests* (North et al. 2009). This management is designed to minimize the potential for direct impacts to denning fisher by implementing LOPs. This management adaptively uses research results to retain and further develop important habitat components, such as: (1) a majority of the large live trees greater than 20 inches dbh; (2) large snags greater than 15 inches dbh, unless they are a safety hazard; (3) black oaks; (4) large portions of the project areas with high canopy cover; and (5) many other important habitat features, such as large woody debris, shrubs, trees with decay characteristics and riparian conservation zones.

Project-level and multi-scale cumulative effects assessment of proposed treatments show that these forest restoration projects would not have significant adverse impacts to fisher habitat or fisher populations. For example, during the 6-year period of 2010-2015, the treatment rate of fisher habitat within the two Ranger Districts ranges from 1.8 to 5.7 percent of habitat available,

depending on which habitat definition is used (Table 50). When considering the treatments across the entire SNF, treatment rates are at 3.0 percent or 3.5 percent of habitat available, depending on which habitat definition is used (Table50).

These treatment rates are reasonable and sustainable between 4% and 8%, even when comparing the treatment rates derived from two different habitat definitions (CWHR and CBI) within a 6 year period. Some of these rates even fall short of those recommended by the CBI for greatly reducing fire sizes and fire severity, which is needed to help sustain fisher habitat. In their comprehensive report entitled: *Baseline Assessment of Fisher Habitat and Population Status & Effects of Fires and Fuels Management on Fishers in the Southern Sierra Nevada* (Spencer et al., 2008), the CBI states (pg. 98):

"Our simulations suggest that treatment rates on the order of 4% to 8% of treatable area every 5 years can significantly reduce fire sizes and fire severity and thereby benefit fishers." (Spencer et al., 2008).

The CBI report (pg. 99) goes on to state:

"*Our simulation results suggest that placing treatments inside fisher habitat is not necessarily detrimental to fisher (at least for the limited range or treatment types and at the scale we simulated). The positive indirect effect of treatments in reducing fire size and severity can help protect fisher habitat value despite potential short-term, localized, negative effects on fisher.* ***Because treatment effects on fire spread are relatively local, treatments inside landscape-level fisher habitat (areas of large tree biomass) may better protect fisher habitat than those placed outside fisher habitat*** *(at least under the baseline fire regime). However, treatments in high biomass areas should still strive to maintain sufficient overstory canopy and avoid removing fisher habitat elements, such as large old trees that provide resting structures.*" (Spencer et al., 2008) [emphasis added]

Rick Truex, a USFS fisher scientist believes fishers may have increased their spatial distribution on SNF since the mid-1990s and that the annual occupancy rate within SNF seems to be consistent, though the spatial pattern of detections appears more variable among years than on the Sequoia NF (Truex pers. comm.). Additionally, two fisher research projects on SNF (Kings River and SNAMP) conducted from 2007 through 2010 have shown fisher populations remain stable or potentially slightly increasing (Craig Thompson, 2011, pers. comm.). The combination of a stable or slightly increasing amount of suitable fisher habitat on the SNF and perhaps an increasing spatial distribution of fishers make it reasonable to conclude the cumulative effects of vegetation management activities on SNF have not reduced overall habitat suitability for fisher sustainability on the Forest. Also as stated before, a recent analysis of the SNFPA Long Term Monitoring data was completed which analyzed a core of 223 sample unit from 2002 through 2009 (Zielinski et. al 2013). Findings suggest that over the 8-year period, there was no trend or statistically important variations in fisher occupancy rates in the southern Sierra populations, however, given variety of continuing risk factors, continued monitoring is highly favored.

All of the current and foreseeable projects on national forest lands include management provisions that sustain fisher populations, as directed by Forest Service Standards and Guidelines and other wildlife conservation management requirements. All of these projects also will be analyzed through the NEPA process, which will help ensure management effects on species are considered. As a result, the potential effects of all action alternatives of the Project are not expected to create significant adverse cumulative effects to fisher habitat.

Level 4 = Southern Sierra Fisher Conservation Area (SSFCA)

The SSFCA is approximately 720,456 acres on the Forest. Almost the entire Project boundary is within the SSFCA. Of those acres, approximately 5,682 acres that are within the SSFCA have some type of treatment; 3,259 acres are within high/moderate mortality (>50% BA loss) and 2,423 acres are within the moderate/low category (<50% basal area loss).

Level 5 = Sierra Nevada Region

Stanislaus and Sequoia National Forests: The Stanislaus NF is implementing several ecological restoration projects including the Middle Fork, Monotti, and Baily Projects. These projects are not expected to result in a change in CWHR size class and cover type, though there would be a 15% reduction in canopy. The predicted habitat value for fisher would remain at 4M on these projects. The Stanislaus recently analyzed the Rim Fire under an EIS. The Sequoia NF is working on three ecological restoration projects within a commercial thinning component (Frog, Rancheria and Joey)). These projects will have a woody debris retention standards as well as an LOP to reduce disturbance effects to fisher during the reproductive period.

While present and reasonably foreseeable vegetation treatments occurring or proposed on the Sierra, Stanislaus, and Sequoia NFs will result in temporary reductions to some limited acres of fisher habitat suitability, these effects overall are short term, and will reduce the risk of uncharacteristically severe wildfire. Uncharacteristically severe wildfire, such as the recent Rim and King Fires can cause significant long-term habitat degradation and fragmentation. Projects are predicted to ultimately result in an increase of the quality and amount of fisher habitat within project boundaries over the long term.

Summary of Fisher Habitat and Population on the SNF

Suitable fisher habitat on the SNF has increased slightly since the mid-1990's. For example, from 1995 to 2005 fisher habitat increased from 422,000 acres to 449,000 acres (USDA Forest Service 2006b), and we estimate there is a similar rate of increase since 2005 as a result of the ecological management that we have implemented. Rick Truex, a USDA Forest Service fisher scientist believes fishers may have increased their spatial distribution on the SNF since the mid-1990s, and that the annual occupancy rate within SNF seems to be consistent, though the spatial pattern of detections appears more variable among years than on the Sequoia NF (Truex pers. comm.). The combination of a stable or slightly increasing amount of suitable fisher habitat on the SNF and perhaps an increasing spatial distribution of fishers make it reasonable to conclude the cumulative effects of vegetation management activities on the SNF have not reduced overall habitat suitability for fishers on the Forest.

This follows with data presented by Jody Tucker at the Western Section TWS fisher symposium in 2012, which displayed results from the Southern Sierra Nevada Carnivore Monitoring Program indicating the occupancy status of the southern Sierra Nevada fisher population from 2002-2009 was stable. (Tucker, 2012) These results are now published in the Journal of Fish and Wildlife Management: "Constant and positive persistence values suggested that sample units rarely changed status from occupied to unoccupied or vice versa. The small population of fishers in the southern Sierra (probably <250 individuals) does not appear to be decreasing" (Zielinski et al, 2013).

In addition, the CDFG in their Evaluation of Petition: Request of the Center for Biological Diversity to list the Pacific fisher (CDFG 2008) found that the information provided, and that was evaluated by the Department, did not indicate an immediate or substantial change in either

population or distribution of fishers since the selected benchmark analysis period beginning with the assessment provided by Grinnell et al. (1937). Based on this information, the Department finds that the fisher has sustained itself since the Grinnell period, with no evidence of recent, immediate, or large change in population or distribution, despite a decline in late successional forest. Available information suggests this may be the case for a number of reasons. Recent studies of fisher habitat use, occurrence, and movement patterns indicate fishers also use managed forest habitats of mixed tree age structure and canopy closure, which have essential attributes such as snag/large tree attributes remaining for resting/denning. Fishers are no longer subject to the major mortality factors of trapping and poisoning of prey that were common in past decades. Forest management in California has been trending toward more development and retention of late successional stands and this change in management activity likely has been, and will be, beneficial to species such as the fisher in the future.

Based on the above analysis of potential impacts within the project area and in consideration of other past, present, ongoing and reasonably foreseeable actions from within the range of the Southern Sierra fisher population, it was determined that implementing the proposed action would not contribute to considerable cumulative effects to Pacific fishers or their habitat. Proposed activities would not further reduce canopy cover because no live trees would be removed. Project activities also could temporarily reduce prey availability through loss of habitat, mortality of small mammals or behavioral changes. Because prey species have relatively rapid reproduction rates, this effect would be expected to be short-term in duration. Sufficient acres of high and moderate severity fire-affected habitat would be retained for fisher to utilize when foraging. Sufficient levels of snags and large woody debris would be retained across the landscape to provide legacy structures for fishers. Future risk of catastrophic fire in the project area would be reduced since fuels would be removed in key strategic areas which would protect future habitat from effects of severe, stand-replacing fire. This determination is supported by recent findings published by both the USFWS and the State of California with regard to fisher population viability and habitat sustainability.

Determination

The BA/BE has determined that implementation of Alternative 1 **may affect but is not likely to jeopardize the continued existence of the Pacific fisher.** Stands which burned in the high/moderate mortality category would remain untreated which in turn would not be habitat in the foreseeable future for fisher. Fisher may use some of the areas for foraging but the majority would not be suitable denning habitat (dense coniferous forest) in the foreseeable future. Connectivity between Fisher Core populations 4 and 5 may be substantially compromised by the level of high severity fire impacts to vegetation within the key linkage area “D” between Core populations 4 and 5 across the San Joaquin River. This area would not be reforested under the No Action alternative.

Indirect effects of no action include the potential for future wildfire and its impact on habitat development and recovery. The fuel loads that would be left by this alternative would make future wildfires in the area difficult to suppress and create a more intense burn, which could lead to increased rates of spread resulting in potential loss of additional suitable fisher habitat and other important habitat attributes such as large trees, large snags, and down woody material. The occurrence of another large fire within the analysis area would further fragment fisher habitat and could cause vegetation type conversions from coniferous forest to chaparral/brush.

The BA/BE has determined that implementation of an action Alternative, 2-5 **may affect but is not likely to jeopardize the continued existence of the Pacific fisher.** Suitable fire-affected

fisher habitat occurs within the project area, and the proposed actions would not result in large reductions of that habitat (CWHR 2.1 habitat) at the project level, unit level, female home range level, or at the regional level for the SSFCA. Sufficient levels of large live trees ≥20”dbh, and large snags ≥15”dbh that provide potential den and rest sites, would be maintained, even under the most aggressive action alternative. Sufficient levels of large woody debris would be retained throughout treatment areas. This project does not propose to remove any oaks unless they are a hazard tree, and measures would be implemented to protect black oaks. A few fishers may be disturbed by Project activities, although this only would be for the short-term duration of those actions. Most importantly, intensive management actions, throughout all suitable fisher habitat, would not occur during the fisher breeding season because a LOP would be implemented. The Project would not impede movement or dispersal to other currently connected suitable habitat areas because habitat connectivity would be maintained within and adjoining the project area where it currently exists. Additionally, if an action alternative is chosen, reforestation would occur, promoting reestablishment of coniferous forest habitat within the Key Linkage Area “D” between fisher core population areas 4 and 5 across the San Joaquin River.

All action alternatives also may result in long-term positive effects to the fisher by: 1) reducing the potential for another future, uncharacteristically severe, stand eliminating wildfire; and 2) promoting the growth of conifer forest, which provides forage for prey species, as well as hiding and thermal cover. All of these factors combined outweigh the short-term negative effects of treatments (due to immediate partial loss of forest biomass and disturbance), especially considering that a more severe fire regime is predicted for the future, and without fuels reduction, large scale, stand replacing wildfires would most likely cause serious and substantial impacts to the population.

3.10. Watershed (Hydrology)

3.10. 1. Background and Affected Environment

Burned landscapes can be more sensitive to disturbance than unburned landscapes, and fire salvage can be controversial (Beschta et al 2004, Karr et al 2004, Reeves et al 2006).

French Fire Burn Summary

The French Fire burned in dense mixed conifer forest on slopes and drainages that have not burned in recent years. Soil burn severity was mapped as part of the BAER analysis. The BAER Team assessment found the overall soil burn severity for the 13,835 acre French Fire to be: 10% high, 48% moderate, 32% low, and 10% very low to unburned (Table 51). It also shows the burn severity by HUC12 watershed.

Table 50. Burn Area Reflectance Classification (BARC) map burn severity %breakout.

Soil Burn Severity Acres				
Unburned	Low	Moderate	High	Total
1,395	4,389	6,615	1,436	13, 835
10%	32%	48%	10%	

Water Quality

Fire Effects to Water Quality

Fire-affected watersheds have the potential for increased runoff, erosion, sediment yield, turbidity, and increasing water temperatures. These effects are due in part to the loss of canopy interception of the precipitation, decreasing evapotranspiration, and consumption of ground cover, which collectively can greatly increase runoff volume, velocity and base flow to streams (Wondzell and King, 2003).

Sediment yield increases are usually the highest the first year following a fire (Robichaud et al., 2000), then decease as groundcover increases, vegetation becomes established, and water repellency recovers (Neary et al 2005, Shakesby and Doerr 2006). Some studies have found that more of the observed sediment load increases were due to in-channel erosion than to hillslope erosion (Shakesby and Doerr 2006). Wondzell and King (2003) note that it is difficult to determine how large episodic sediment inputs factor into the sediment budget of a watershed, but that post-fire mass-wasting events such as landslides and debris flows exert lasting effects on stream channel morphology.

The temperature of a stream is generally expected to increase where fire has removed trees that previously provided shading along perennial streams. This effect is expected to be proportional to the length of channel where canopy loss has occurred. This is most likely to have occurred in the areas identified as high mortality, including the proposed fire salvage treatment areas.

Prior to the French Fire, water quality in the project area creeks was considered good, with no known turbidity, temperature or sediment issues. Although no V-Star surveys have been conducted in the area, S-Star surveys of creeks showed fine sediment filling of most pools to be within Desired Condition (Table 52).

Table 51. S-Star values measured in perennial and intermittent creeks within the burn area.

Subdrainage	Creek	S-Star (%)	Desired Condition* (%)
523.6051	Fish Creek	40.0	<30
523.6002	Trib. to Fish Creek	13.0	<30
523.6001	Fish Creek above Trib.	20.0	<30
523.7051	Un-named Trib. to Rock Creek	47.0	<30
523.7002	Slide Creek	9.0	<30
523.7052	Rock Creek	6.0	<30
523.0030	Trib. to Shakeflat Creek	13.0	<20
523.0030	Shakeflat Creek	10.5	<20
506.1001	Trib. to WF Chiquito Creek	15.4	<30

* <30% fine sediment based on the presence and preponderance of Holland Family and/or Ultic Haploxeralf soils; <20% based on all other (less friable) soil types.

3.10.1.1. Indicators

Indicator 1: Channel Stability

Channel stability measurements from Pfankuch surveys were used as an indicator of possible channel response to increases in flow that may result from project implementation. The Pfankuch

survey method was developed to evaluate the stream channel condition and stability from within the floodplain and stream channel. This method takes into account a total of 15 attributes from the upper banks, lower banks, and channel bottom. Each attribute is assigned a numeric value based on the observations made in the field. When the attributes are tallied, they are categorized into four different ratings, which are poor, fair, good, or excellent.

Indicator 2: Channel Type

Rosgen channel type (Rosgen 1996) is also used as an indicator of sensitivity to disturbance (Stone 2015, French Hydrology Report, page 7). The majority of stream channels in the project area have been classified using the Rosgen classification system (Rosgen, 1994). “Disturbance” includes changes in flow and sediment supply coming from upstream. Table 53 shows these attributes from the Pfankuch surveys conducted in 2014.

Table 52. Reaches in the project area where modified Pfankuch surveys were conducted in 2014. The interpretation of sensitivity to disturbance comes from Table 8-1 in Rosgen (1996) and professional judgment.

Reach	Subdrainage	Channel Type	Sensitivity to Disturbance	Modified Pfankuch Rating
				Existing Stream Type
Ross Creek	523.5003	G4	Very High *	119 (Fair)
Trib. Fish Creek	523.6002	A3	Very High	121 (Fair)
Fish Creek	532.6001	B3	Low	75 (fair)
Trib. Rock Creek	523.7001	G4	Extreme	131 (Poor)
Trib. Rock Creek	523.7051	A4	Extreme	89 (Good)
Rock Creek	523.7052	B2	Very Low	45 (Good)
Slide Creek	523.7002	A3	Very High	85 (Good)
Trib. San Joaquin River	523.0028	A4	Extreme	98 (Fair)
Trib. Shakeflat Creek	523.0030	A3	Very High	68 (Good)
Trib. WF Chiquito Creek	506.1001	A3	High *	54 (Good)
Trib. WF Chiquito Creek	506.1002	A3	High *	57 (Good)
WF Chiquito Creek	506.1051	A2	Very Low	43 (Good)
Fish Creek	532.6051	F2	Low	101 (Fair)
Shakeflat Creek	523.0030	B3	Low	54 (Good)

* Adjusted sensitivity rating due to professional judgment.

3.10.2. Environmental Consequences

Cumulative Watershed Effects

Cumulative watershed effects (CWE) are those that result from the incremental impacts of the proposed action when added to past, present, and reasonably foreseeable future actions. Cumulative watershed effects can result from individually minor but collectively significant actions taking place over space and time. The objective of CWE analysis is to protect the identified beneficial uses of water from the combined effects of multiple management activities.

A CWE analysis was conducted following established protocol, consistent with Regional Methodology for CWE assessment described in Forest Service Handbook 2509.22. This method assumes that an acre of road represents the greatest (common) management disturbance, and normalizes all other activities to this standard, called Equivalent Roaded Acres (ERAs). Established coefficients are used to convert acres of other land disturbing activities into ERAs.

8th-Field scale subdrainages ("HUC8") are used for spatial analysis for ERA's.These subdrainages range in size from 3000 to 250 acres. The "%ERA" is the percentage of the watershed that is impacted by roads or road-equivalent disturbance. Watershed sensitivity is determined by evaluating various geological conditions (e.g., landslide potential, soil type, channel bifurcation ratio), which rates the watershed's Lower Threshold of Concern (or TOC %). For example, a 4% Lower TOC % is considered very sensitive to disturbance, 5% moderately sensitive, and 6% as having low sensitivity to disturbance. If the %ERA exceeds the Lower TOC %, then a Detailed IDT Field Assessment is triggered to determine if a CWE response is occurring or could occur as a result of project activities. The upper limit for the TOC % is 14%. The upper TOC of 14% does not represent the exact point at which cumulative watershed effects will occur. Rather, it serves as a "yellow flag" indicator of increasing susceptibility of a CWE response. If a subdrainage has a total %ERA (including baseline conditions, Proposed Action and reasonably foreseeable future actions) equal to or greater than 14%, then ground disturbing activity (e.g., tractor logging) would be reduced, modified, and/or mitigation with site-specific design criteria and BMP's to reduce the probability of a CWE response.

Disturbance activities include roads and OHV trails; past, present, and foreseeable vegetation management and logging activity, grazing; and land development. All known disturbances that occurred within the past 30 years and all reasonably foreseeable disturbances are included in the ERA analysis.

Management actions are generally planned to prevent ERAs from exceeding 14%; however, in very small HUC8s, even a small amount of disturbance can result in greater than 14% ERA. In addition, events such as wildfires can result in much higher ERA values. In the range between the two thresholds, Detailed IDT Field Assessments are used to identify if a particular action is expected to alter the risk of CWEs. This includes a comparison of actual contributing drainage area above the subdrainage pour point and the HUC8 analysis unit to identify the degree of potential attenuation of a CWE response at a HUC8 scale.

There are limitations to the ERA model, including: ERAs are only an indicator and cannot be used to estimate quantitative changes in stream channel conditions; the higher risk associated with near-stream disturbance (as opposed to disturbance far from any stream channel) is not factored into the analysis; and the method does not account for site specific BMPs (i.e., all roads are weighted the same, regardless of their management and condition). The Detailed IDT Field Assessment allows for more specific knowledge of the area, including the position of past and proposed disturbances relative to the drainage network, whether BMPs are in place, and the sensitivity and condition of stream channels, to be factored into the final determination of the risk for CWEs.

CWE Results

23 HUC 8 subdrainages were analyzed for CWE. Pre-fire baseline conditions show only one subdrainage (506.6001) exceeding the lower TOC%. Post-fire baseline shows that 17 of the 23 subdrainages exceeded the Lower TOC% and one (523.7001) exceeded the upper TOC% of 14%.). As a result, a Detailed IDT Field Assessment was conducted on all (safely accessible)

subdrainages exceeding threshold. Pfankuch and S-Star surveys were completed on main stem streams to determine actual watershed integrity and the potential for CWE response. Post-project CWE analysis for the first entry units (including DFPZ's), road side hazard treatment, and plantations showed that all but two subdrainages (506.1002, 506.1051) exceeded the Lower TOC% and 11 subdrainages exceeded the upper TOC% of 14% .The second entry units (which take into account two years of prorated recovery of the baseline ERA values from the previous project activities) showed that all but two subdrainages (506.1002, 506.1051) exceeded the Lower TOC% and ten subdrainages exceeded the upper TOC% of 14%.

3.10.3. Alternative 1 – (No Action)

Direct and Indirect Effects

There would be no direct effects from ground-disturbing activities with the No Action alternative (Alternative 1). Indirect effects would be those associated with post-fire hydrologic response and hill slope erosion processes. Watershed response in the burned watersheds can change substantially as compared to pre-fire conditions. Consumption of organic material and high soil heating can promote the formation of water repellent "hydrophobic" layers, at or near the soil surface, which can result in the loss of soil structural stability and infiltration capacity. With hydrophobic soils in the moderate to high soil burn severity (SBS) areas now partially to completely devoid of vegetation and groundcover, the first large runoff producing storms will likely create increased surface flow volumes and velocities that can transport available sediment and ash from the slopes and along the channel bottoms. This scenario, coupled with existing wet antecedent soil conditions from previous storms, could cause an increase in peak flow and water yield in subdrainages with high SBS. Moreover, continued die off of fire-stressed living trees from insect mortality could increase available baseflow, thus increasing water yield. Increases in water yield and peak flow response could in turn increase bank erosion rates in streams, which may affect water quality. These indirect effects would occur regardless of whether or not trees are harvested. Vegetative recovery of ground cover (e.g., bear clover) is expected to occur in the first three to five years after the fire, greatly reducing hill slope susceptibility to erosion and sediment delivery to sensitive riparian areas. In the long term (5 to 10 years), vegetation would sufficiently recover to return baseflows to pre-fire conditions. Any potential effects to channel stability and water quality from post-fire hydrologic response would also attenuate with time, returning to a state of equilibrium in the long term.

Cumulative Effects

ERA's for Alternative 1 would be the same as exiting baseline conditions for the Project subdrainages. Baseline ERA's would include established disturbances (e.g., roads, trails), prior timber harvest activity, riparian range impacts from livestock, and the soil burn severity from the French Fire. Post-fire baseline shows that 17 of the 23 subdrainages analyzed exceeded the Lower TOC% and one (523.7001) exceeded the upper TOC% of 14%.As a result, a detailed IDT field assessment was conducted on all (safely accessible) subdrainages exceeding the lower TOC threshold. Pfankuch and S-Star surveys were completed on main stem streams to determine actual watershed integrity and the potential for CWE response (Tables 53 and 53).

Cumulative watershed effects could increase if ongoing mortality affects peak flows, overland flow, and hillslope and in-channel erosion. ERAs and effects from the French Fire would recover rapidly for the first 3-5 years with full recovery expected in about 10 years, but overall recovery could be delayed by effects from the secondary insect mortality. In addition, if another fire occurs

under conditions similar to the French Fire, the increased fuel loading in insect affected areas would increase the potential for high burn severity. This could result in another episode of CWEs that would be reflected by another spike in ERAs.

3.10.4. Alternative 2 - Proposed Action

Direct and Indirect Effects

Indicator 1 and 2: Flows and Channel Stability

The trees identified for harvest would be fire-injured, fire-killed, or killed by post-fire insect attack, thus, effects to water yield due to altered interception and evapotranspiration as a result of their removal would be small and immeasurable (Troendle et al 2010, Campbell and Morris 1988). Recovery of flows from fire effects would be unaffected by this alternative.

The Project is not expected to affect channel stability. Direct impacts to channels are avoided or minimized with design measures including delineation of SMZs, designation of stream crossings, and other BMPs. Indirect effects that could occur in the case of increased flow or sediment delivery from adjacent hillslopes are also not expected, since hillslope effects have also been minimized. There could be indirect effects resulting from equipment operation in un-scoured ephemeral Class V swales, which will not have SMZs. Sediment could be mobilized from these areas and carried into the channel network.

Cumulative Effects

Increasing groundcover in treatment units will help prevent erosion in these areas when it is most likely to occur, which is within the first few years following a fire. BAER road work does not affect the ERA model but would help lower risk of cumulative watershed effects by minimizing road surface erosion, disconnecting road/stream connectivity, and removing or replacing culverts that are undersized for the larger post-fire flows that are expected. Overall, the project would have minor positive effects where more groundcover was left on the slopes, particularly on steeper slopes and in SMZs in High SBS areas. However, the overall change in condition of the watersheds from the project would be negligible and unmeasurable. Fire effects would still dominate watershed response, even if the project mitigates them somewhat in limited areas. Effects on beneficial uses would be the same as described under the Cumulative Effects of Alternative 1.

23 HUC 8 subdrainages were analyzed for CWE. Pre-fire baseline conditions show only one subdrainage (506.6001) exceeding the lower TOC%. Post-fire baseline shows that 17 of the 23 subdrainages exceeded the Lower TOC% and one (523.7001) exceeded the upper TOC% of 14%. Post-project CWE analysis for the first entry units (including DFPZ's), road side hazard treatment, and plantations showed that all but two subdrainages (506.1002, 506.1051) exceeded the Lower TOC% and 11 subdrainages exceeded the upper TOC% of 14% (506.0051, 506.1001, 523.0021, 523.0028, 523.0030, 523.0063, 523.0064, 523.6051, 523.7001, 523.7051, 523.7052) (Table 11). The second entry units (which take into account two years of prorated recovery of the baseline ERA values from the previous project activities) showed that all but two subdrainages (506.1002, 506.1051) exceeded the Lower TOC% and ten subdrainages exceeded the upper TOC% of 14% (506.0051, 506.1001, 523.0021, 523.0028, 523.0030, 523.0063, 523.6051, 523.7001, 523.7051, 523.7052) (Table 12).

The Detailed IDT Field Assessments of these subdrainages concluded that the potential for the Project to contribute to CWEs is low.

3.10.5. Alternative 3 – (No Herbicide)

Direct and Indirect Effects

Alternative 3 would not include use of herbicides (glyphosate). Instead, site preparation, treatment of invasive weeds, and release of planted seedlings would be accomplished with mechanical methods (either hand or heavy equipment).

The effects described for the use of glyphosate do not apply to this alternative. Using mechanical means to control bear clover for reforestation (e.g., blading or tilling) would require the clearing (by dozer piling) each area of downed woody material to allow for effective mechanical release. The loss of ground cover and disruption of the soil structure over 2300 acres would exacerbate CWE conditions, potentially leading to accelerated erosion and sediment delivery to streams. As such, hand grubbing would be the only viable option in avoiding a CWE response.

Cumulative Effects

The post-fire watershed response would be the same in this alternative as described for alternative 2 and thus the cumulative effects of this alternative would be the same as described for alternative 2.

3.10.6. Alternative 4 – (Hazard Tree and Plantation Salvage Only)

Direct and Indirect Effects

The effects of this alternative would be the same as described for alternative 2.

Cumulative Effects

ERAs would be similar to Alternative 2, but slightly lower in 16 subdrainages The reductions range from 7.7% to 0.1%. Two subdrainages (506.0051 and 523.6002) would have decreased CWE potential and would be rated as “Not Expected”. Less disturbance is slightly beneficial to watersheds; however, the post-fire response would still dominate at all scales (HUC8, drainage, subwatershed, project-area, and San Joaquin River), and there would be no difference in cumulative effects. The cumulative effects of this alternative would be the same as described for Alternative 2.

3.10.7. Alternative 5 – (No Secondary Entry)

Direct and Indirect Effects

The effects of this alternative would be the same as described for alternative 2.

Cumulative Effects

Two subdrainages (523.6002, 523.7052) would have slightly lower %ERA values, but the CWE response potential would remain the same (Table 14). As such, the cumulative effects of this alternative would be the same as described for alternative 2.

3.10.8. Alternative 5 – (No Secondary Entry)

Cumulative Effects

Two subdrainages (523.6002, 523.7052) would have slightly lower %ERA values, but the CWE response potential would remain the same. As such, the cumulative effects of this alternative would be the same as described for alternative 2.

4.0. Chapter 4. – Preparers and Coordination

4.1 Preparers and Contributors

The individuals listed are members of the Interdisciplinary Team for the Project. These specialists, as well as other District personnel, contributed to the development and analysis of this EA.

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4.2. References

Adams, B. 2014. Personal communication. Hotshot Captain, Sierra National Forest, 57003 Road 225, North Fork, CA 93643.

Agee, J.K.; Franklin, J.F. 2003. Forging a science based national forest fire policy. Issues in science and technology. http://issues.org/20-1/franklin/ (26 July 2015).

Agee, J.K.; Skinner, C.N. 2005. Basic principles of forest fuel reduction treatments. Forest ecology and management 211: 83–96.

Ahuja, S., Suighara, .N 2006. Fire in California ecosystems. 481-498pp.

Aidoo, A.; Gao, N.; Neft, R.E.; Schol, H.M.; Hass, B.S.; Minor, R.Y.; Heflich, R.H.. 1990. Evaluation of the genotoxicity of gentian violet in bacterial and mammalian cell systems. Teratog. carcinogen. mutagen. 10(6): 449-462.

Allen, A.W. 1987. The relationship between habitat and furbearers. in wild Furbearer management and conservation in North America. 164-179pp.

Anderson, H. E. 1982. Aids to determining fuel models for estimating fire behavior. USDA Forest Service. Intermountain Forest and Range Experiment Station. Gen. Tech. Rep. – INT-122, Ogden, Utah. 22p.

Angwin, P.; Cluck,D.R.; Zambino, P.J.; Oblinger, B.W. ; Woodruff, W.C. 2012. Hazard tree guidelines for Forest Service facilities and roads in the Pacific Southwest Region. USDA Forest Service, Forest Health Protection, Report RO-12-01.

Armour, C.; Duff, D.;Elmore, W.;. 1994. The effects of livestock grazing on western riparian and stream ecosystem. Fisheries. Vol. 199, No.9, 9-12pp.

Ashton, D.T.; Lind, A.J.; Schlick. K.E.; 1997. Western pond turtle, natural history. Pacific Southwest Research Station, Redwood Laboratory, USDA Forest Service.

Atkins, E. L. 1987. Laboratory Bee Adult Toxicity Tests (BATDT) for boric acid, powdered, 100% technical. MRID 40269201.

Aubry, K.B.; Houston, D.B. 1992. Distribution and status of the fisher (*Martes pennanti*) in Washington. Northwestern Naturalist 73:379-85.

Baker, M.D.; Lacki, M.J.; Falxa, G.A. 2008. Habitat use of pallid bats in coniferous forests of northern California. Northwest Science, 82: 269-275.

Bakke, D. 2001. A review and assessment of the results of water monitoring for herbicide residues for the years 1991 to 1999. Vallejo, CA: Region 5, USDA Forest Service.

Bakke, David. 2007. Unpublished Document. Analysis of issues surrounding the use of spray adjuvants with herbicides. USDA Forest Service, Pacific Southwest Region, Vallejo, CA. http://www.fs.fed.us/r5/spf/fhp/pesticide/surfactants _Jan_07_update.pdf (3 March 2013).

Barbour, R.W.; Davis, W.H.; 1969. Bats of America. University of Kentucky Press, Lexington, KY, 286p.

Barbour, M. G.; Burk,. J. H.; 1980. Terrestrial plant ecology. Benjamin/Cummings Publishing Company, Inc. Menlo Park, California. 604p.

Bartelt, P.E. 1998. Natural history notes: Bufo boreas mortality. Herpetological review 29(2):96.

Beaty, M.; Taylor, A. 2008. Fire history and the structure and dynamics of a mixed conifer forest landscape in the northern Sierra Nevada, Lake Tahoe Basin, California, USA.

Beche, Leah A., Scott L. Stephens and Vincent H. Resh. 2005. Effects of prescribed fire on a Sierra Nevada (California, USA) stream and its riparian zone. Forest Ecology and Management, 218:37-59.

Bekker, M. F., Taylor, A. H. 2001. Gradient analysis of fire regimes in montane forests of the southern Cascade Range, Thousand Lakes Wilderness, California, USA. Plant ecology, 155(1), 15-28.

Belsky, A.J., Matzke, A., Uselman S. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Watershed Conservation, Vol. 54, 419-431pp.

Benavides-Solorio, J., MacDonald, L.E. 2001. Post-fire runoff and erosion from simulated rainfall on small plots, Colorado Front Range. Hydrological Processes, 15:2931-2952.

Benedict, M.; Buck, J.M., 1938. Timber management plan Chiquito Working Circle Sierra National Forest. U.S. Department of Agriculture. Forest Service. Sierra National Forest. 129p.

Beschta, R.L.; Rhodes, J.J.; Kauffman, J.B.; Gresswell, R.E.; Minshall, G.W.; Karr, J.R.; Perry, D.A.; Hauer, F.R.; Frissell. C.A. 2004. Post fire management on forested public lands of the western United States. Conservation Biology, 18(4): 957–967.

Beschta, R.L.; Frissell, C A.; Gresswell, R.; Hauer, R.; Karr, J.R.; Minshall, G.W.; Perry, D.A.; Rhodes, J.J. 1995 Wildfire and salvage logging. [In press].

Bias, M.A., Gutiérrez, R.J.; 1992. Habitat associations of California Spotted Owls in the central Sierra Nevada. Journal of Wildlife Management. 56:584-596.

Binkley, D.; Bird, S.; Ryan, M.G.; Rhoades, C.C. 2003. Impact of wood chips on forest soil temperature, moisture, and nitrogen supply. Report to Interior West Center for the innovative use of small diameter wood. In: Dwire, K.A, Rhoades, C.C., Young, M.K. 2010. Potential Effects of Fuel Management Activities on Riparian Areas. Gen. Tech. Rep. RMRS-GTR-231, Department of Agriculture, Forest Service, Rocky Mountain Research Station. Chapter 10 pp 175-205. 2010. p. 99 of 128 Aquatic Species Biological Assessment and Evaluation for the Soaproot Project 2012 Sierra National Forest, High Sierra Ranger District.

Birge W.J.; Black J.A.; 1977. Sensitivity of vertebrate embryos to boron compounds. EPA-560/1-76- 008, prepared by University of Kentucky, Lexington KY, under contract No. 68-01-3920, Office of Toxic Substances, US EPA, Washington, DC.

Bisson, P.A.; Rieman, B.E.; Luce, C.; Hessburg, P.F.; Lee, D.C.; Kershner, J.L.; Reeves, G.H.; Greswell. R.E.; 2003. Fire in aquatic ecosystems of the western USA: current knowledge and key questions. Forest ecology and management 178(1&2): 213-229.

Biswell, H.H. 1974. Effects of fire on chaparral. Pp 321-364 In Fire and Ecosystems (T.T. Kozlowski and C.E. Ahlgren, editors). Academic Press, New York, New York.

Blakesley, J.A.; Noon, B.R.; Anderson, D.R. 2005. Site occupancy, apparent survival, and reproduction of California spotted owls in relation to forest stand characteristics. The Journal of Wildlife Management. 69: 1554–1564.

Bureau of Land Management (BLM) 2007. BLM Vegetation Treatments Using Herbicides – Appendix D: Evaluation of Risks from Degradates, Polyoxyethylene-amine (POEA) and R-11, and Endrocrine distrupting chemicals. Final Programmatic EIS. June 2007. 40p.

Blumfield, T.J., Xu Z.H. 2003. Impact of harvest residues on soil mineral nitrogen dynamics following clearfall harvesting of a hoop pine plantation in Subtropical Australia. Forest Ecology and Management. 179: 55-67. In Dwire , K.A, Rhoades, C.C., Young, M.K. 2010. Potential Effects of Fuel Management Activities on Riparian Areas. Gen. Tech. Rep. RMRS-GTR-231, Department of Agriculture, Forest Service, Rocky Mountain Research Station. Chapter 10 pp 175-205. 2010.

Boatman, W.I. 2002. Reducing predation by common ravens on desert tortoises in the Mojave and Colorado deserts. U.S. Geological Survey, Western Ecological Research center. [n.p.].

Bock, C.E., Bock J.H.. 1977. Patterns of post fire succession on the Donner Ridge burn, Sierra Nevada. 464-469pp. In Proceedings of the symposium on the environmental consequences of fire and fuel management in mediterranean ecosystems (Mooney H.A., Conrad C.E., technical coordinators). USDA Forest Service, Washington, DC. General Technical Report WO-3.

Bond, M.B., Lee, D.L., Siegel, R.S., Ward, J.P. 2009. Habitat use and selection by California spotted owls in a post fire landscape. J. Wildlife Mgmt. 73: 1116-1124.

Bond, M. L., Lee D.E., Bradley C.M., Hanson C.T.. 2009. Influence of pre-fire tree mortality of fire severity in conifer forests of the San Bernardino Mountains, California. The Open Forest Science Journal, 41-47pp.

Bonin, A.M.; Farquharson, J.B.; Baker, R. SU. 1981. Mutagenicity of arylmethane dyes in salmonella typhimurium.. Mutat. Res. 89(1): 21-34.

Bossard, C. C.; Randall, J. M.; Hoshovsky, M.C. 2000. Invasive plants of California's wildlands. Berkeley, CA: University of California Press: 310-312.

Bowman, M.C.; Rushing, L.G; Thompson, H.G. Jr.; Althaus, J.R.; Schumacher, H.J. 1982. A marker technique to monitor treated industrial wastewater effluents. Sci. Total Environ. 24(2): 159-176

Boyer, R. Grue, C.E. 1995. The need for water quality criteria for frogs. Environ. Health Perspect. 103 4, pp. 352–357.

Bradley, P., Post M., Weller, T. J. 2007. Myotis thysanodes fringed myotis. Western Bat Working Group 2005 [cited 2008]. http://wbwg.org/species_accounts/vespertilonidae/myth.pdf

Breece, C. R., Kolb, T. E., Dickson, B. G., McMillin, J. D., Clancy K. M. 2008. Prescribed fire effects on bark beetle activity and tree mortality in southwestern ponderosa pine forests. Forest Ecology and Management. 255:119-128.

Brode, J.M., Bury, R.B. 1984. The importance of riparian systems to amphibians and reptiles. 30-36pp. in California Riparian Systems (Warner R.E., Hendrix K.M., eds.). Univ. Calif. Press. Berkeley, California. 1035 p.

Brown, J. K. 1989. Effects of fire on streams. In: Richardson, F.; Hamre, R.H., eds. Wild trout IV: Proceedings of the symposium. Washington, DC: U.S. Government Printing Office: 106-110pp.

Brown, J.K.; Reinhardt, Elizabeth D.; Kramer, K.A. 2003. Coarse woody debris: Managing benefits and fire hazard in the recovering forest. Gen. Tech. Rep. RMRS-GTR-105. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Brunellel, A.; Anderson, R.S. 2002. Sedimentary charcoal as an indicator of late-Holocene drought in the Sierra Nevada, California, and its relevance to the future. The Holocene (2003) 13(1): 21–28.

Buck, S.G., Mullis, C., Mossman, A.S., Show, I., C. Collahan. 1994. Habitat use by fishers in adjoining heavily and lightly harvested forest. 368-376pp. in Buskirk, S.W., Harestad, A.S., Raphael, M.G., and R.A. Powell (editors) Martens, sables and fishers: biology and conservation. Cornell University Press, Ithaca, New York.

Burcham, L. T. 1957. California range land: A historic-ecological study of the range resource of California. Sacramento, CA: State of California, Department of Natural Resources, Division of Forestry. 247 p.[186]

Burke, V.J.; Gibbons, J.W. 1995. Terrestrial buffer zones and wetland conservation: A case study of freshwater turtles in a Carolina bay. Conservation Biology. 9: 1365-1369. In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299p.

Bury, R.B. 2004. Wildfire, fuel reduction, and herpetofaunas across diverse landscape mosaics in Northwestern forests. Conservation Biology. 18: 968-975. In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Bury, R.B., Luckenbach, R.A., Busack S.D. 1977. Effects of off-road vehicles on vertebrates in the California desert. United States Department of the Interior, Fish and Wildlife Service, Wildlife Research Report 8, Washington, D.C.

Busse, M.D. et al. 2001. Glyphosate toxicity and the effects of long-term vegetation control on soil microbial communities. Soil Biology and Biochemistry 33, 1777-1789.

Buttar, H.S.; Moffatt J.H.; Bura C.; St-Vil J. 1990. The in vitro embryotoxicity of gentian violet in preimplantation mouse embryos. Teratology. 41(5): 541-542.

California Department of Fish and Game. 2008. and California Interagency Wildlife Task Group. California Wildlife Habitat Relationships (CWHR) version 8.2. personal computer program. Sacramento, California. http://www.dfg.ca.gov/biogeodata/cwhr/cawildlife.asp. (3 January 2008).

California Department of Fish and Game. 2005. California Department of Fish and Game and California Interagency Wildlife Task Group. California Wildlife Habitat Relationships (CWHR) version 8.1. personal computer program. Sacramento, California. http://www.dfg.ca.gov/biogeodata/cwhr/cawildlife.asp. (3 January 2008).

California Invasive Plant Council. 2006. California invasive plant inventory**.** Berkeley, CA: California Invasive Plant Council, publication 2. http://www.cal-ipc.org/ip/inventory/index.php (29 July 2015).

Campbell, R.E., Morris, S.E. 1988. Hydrologic response of Pack River, Idaho, to the Sundance Fire.Northwest Science 62(4): 165-170.

Caprio, et al. 2006. Long-Term effects of the Rainbow Fire, Devils Postpile N.M.Caprio. Keifer, Webster.2006 Extended Abstract. AFE 3rd international Fire Ecol. Congress.

California Air Resources Board, http://www.arb.ca.gov/homepage.htm. (27 July 2015).

Carey, C., Bryant, C. J. 1995. Possible interrelations among environmental toxicants, amphibian development, and decline of amphibian populations. Environmental Health Perspectives. 5 p.

Castelle, A.J., Johnson, A.W., Conolly. D. 1994. Wetland and stream buffer size requirements: A review. Journal of Environmental Quality 23: 878-882. In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Cauble K., Wagner R. S. 2004. Sublethal effects of the herbicide glyphosate on amphibian metamorphosis and development. Bull. Environ. Contam. Toxicol. (2005) 75:429–435.

Central Valley Regional Water Quality Control Board. 2011. Water Quality Control Plan for the Sacramento and San Joaquin River Basins, Fourth Edition. Available via: http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

Chamberlin, T.W., Harr, R.D.,. Everest. F.H. 1991. Timber harvesting, silviculture, and watershed processes. In: Influences of forest and rangeland management on salmonid fishes and their habitats, chapter 6. American Fisheries Society special publication 19. 721 pp.

Chambers, C. L.,Mast, J. N. 2005. Ponderosa pine snag dynamics and cavity excavation following wildfire in northern Arizona. Forest Ecology and Management, 216(1), 227-240.

CHM2HILL. 1995. A Desk Reference for NEPA Air Quality Analysis, USDA Forest Service .

Christensen, M.D; Young, J.A.., Evans, R.A. 1974. Control of annual grasses and revegetation in ponderosa pine woodlands. Journal of Range Management. 27(2): 143-145.

Clark, D.A. 2007. Demography and habitat selection of Northern spotted owls in post fire landscapes of southwestern Oregon. MS thesis. Oregon State University, Corvallis OR.

Clark FD; Frame DD; Jensen MM. 1993. Occlusive laryngotracheitis in turkeys following drinking water administration of Gentian Violet. Avian Dis. 37(1): 226-228.

Clary, W. P., Webster, B.F. 1989. Managing grazing of riparian areas in the Intermountain Region. Gen. Tech. Rep. INT-GTR-263., Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 15pp.

Click, C., Fiske, J., Sherlock, J., Wescom, R. 1994. Alternative to herbicides in the USDA Forest Service, Pacific Southwest Region - 10-year Update. Proceedings of the 15th Annual Forest Vegetation Management Conference. January 25-27, 1994. Redding, CA. 46-60pp.

Click, C., Fiske, J., Sherlock, J., Wescom, R. 1988. Alternative to herbicides - update based on 5-year herbicide use moratorium in the USDA Forest Service, Pacific Southwest Region. Proceedings of the 10th Annual Forest Vegetation Management Conference. November 1-3, 1988. Eureka, CA. 49-90pp.

Clines, J.M. 2015a. Biological Assessment /Biological Evaluation for Threatened, Endangered, and Sensitive Plants; French Fire Recovery and Reforestation Project, Bass Lake Ranger District, Sierra National Forest. Available at BLRD office, North Fork, CA.

Clines, J.M. 2015b. Invasive Weed Risk Assessment; French Fire Recovery and Reforestation Project, Bass Lake Ranger District, Sierra National Forest. Available at BLRD office, North Fork, CA.

Cluck, D. 2014. Post-fire bark beetle activity within the 2012 Chips Fire (FHP Report NE14-07). USDA Forest Service, Susanville, CA, Report No. NE14-07.

Cochran, P. H., Barrett, J. W. 1995. Growth and mortality of ponderosa pine poles thinned to various densities in the Blue Mountains of Oregon. USDA For. Serv. Res. Pap. PNW-RP-483. 27 p.

Coe, D.B. 2006. Sediment production and delivery from forest roads in the Sierra Nevada, California. MS Thesis, Colorado State University, Fort Collins, CO.

Collins, B. M., Roller, G. B. 2013. Early forest dynamics in stand-replacing fire patches in the northern Sierra Nevada, California, USA. Landscape ecology, 28(9), 1801-1813.

Cosmetic Toiletry and Fragrance Association, 1991. CTFA International Cosmetic Ingredient Dictionary. Nikitakis JM; McEwen GN; Wenninger JA (Eds). The Cosmetic Toiletry, and Fragrance Association, Washington, DC. Palmer S; Krueger H. 2001. MON 77360:

An Acute Contact Toxicity Study with the Honey Bee: Lab Project Number: WL-97-099: 139-433. Unpublished study prepared by Wildlife International, Ltd. 20 p. MRID 45370301.

Cox, HN; Moss, C; Hannon, MF. 1989. Compound allergy to a skin marker for patch testing: A chromatographic analysis. Cont. Dermat. 212(1): 12-15.

Crookston, N.L., Dixon, G. E. 2005. The forest vegetation simulator: A review of its structure, content, and applications. Computers and Electronics in Agriculture. 49 (2005): 60–80.

Crotteau, J. S., Varner III, M., Ritchie, M. W. 2013. Post-fire regeneration across a fire severity gradient in the southern Cascades. Forest Ecology and Management, 287, 103-112pp.

Croyle, Z. 2013. Equivalent Roaded Area (ERA) Disturbance Coefficients, Ramsey Fire Salvage Project, Stanislaus National Forest, Calaveras Ranger District. 4p.

Dahl, B. E.; Tisdale, E. W. 1975. Environmental factors related to medusahead distribution. Journal of Range Management. 28(6): 463-468.

D'Antonio, C.M.; Vitousek, P.M. 1992. Biological invasions by exotic grasses, the grass/fire cycle, and global change. Annual Review of Ecological Systems. 23: 63-87.

Dark, S.J. 1997. A landscape-scale analysis of mammalian carnivore distribution and habitat use by fisher. M.S. Thesis, Humboldt State Univ. 67 p.

Davis, F.W., Seo, C., Zielinski,W.J. 2007. Regional variation in home-range scale habitat models for fisher (*Martes pennanti*) in California. Ecological Applications 17:2195–2213.

Davis, R., Hood, S., Bentz, B.J. 2012. Fire-injured ponderosa pines provide a pulsed resource for bark beetles. Canadian Journal of Forest Research. 2002-2036pp.

Davis, W.H.,. Hitchcock, H. B. 1965. Biology and migration of the bat, myotis lucifugus, in New England. Journal of Mammalogy 46 (2):296-313.

De Solla, S.R.,. Martin, P.A 2011. Absorption of current use pesticides by snapping turtle (*Chelydra serpentine*) eggs in treated soil. Chemosphere. Vol 85, Issue 5. pp 820-825 October 2011.

DellaSala, D.A.,. Bond, M.L., Hanson, C.T., Hutto, R.L., Odion, D.C. 2014. Complex early seral forests of the Sierra Nevada: What are they and how can they be managed for ecological integrity? Natural Areas Journal 34:310-324.

DiTomaso, J.M., Kyser , G.B. et al. 2013. Weed control in Natural Areas in the Western United States. Weed Research and Information Center, University of California. 54 pp.

Dixon, G.E., 1994. Western Sierra Nevada Prognosis geographic variant of the Forest Vegetation Simulator. WO Timber Management Service Center, USDA- Forest Service, Fort Collins, CO.

Donato, D.C., Fontaine, J. B., Campbell, J. L., Robinson, W. D., Kauffman, J. B., Law, B. E. 2006. Post- wildfire logging hinders regeneration and increases fire risk. Science, 311(5759), 352-352.

Donato, D.C., Fontaine, J. B., Robinson, W. D., Kauffman, J. B., Law, B. E. 2009. Vegetation response to a short interval between high-severity wildfires in a mixed-evergreen forest. Journal of Ecology, 97(1), 142-154.

Dugger, K.M.; Anthony, R.G.; Andrews, L.S. 2011. Transient dynamics of invasive competition: barred owls, spotted owls, habitat, and the demons of competition present. Ecological Applications. 21(7): 2459–2468.

Dugger, K.M.; Wagner, F.; Anthony, R.G.; Olson, G.S. 2005. The relationship between habitat characteristics and demographic performance of northern spotted owls in southern Oregon. Condor. 107: 863–878.

Dunham, J.B., Young, M. K., Gresswell, R. E., Rieman, B.E. 2003. Effects of fire on fish populations: landscape perspectives on persistence of native fishes and nonnative fish invasions. Manuscript.

Dunning, D., Reineke, L. H. 1933. Preliminary yield tables for second-growth stands in the California pine regions .Vol. 351. US Dept. of Agriculture.

Dwire , K.A, Rhoades, C.C., Young, M.K. 2010. Potential effects of fuel management activities on riparian areas. Gen. Tech. Rep. RMRS-GTR-231. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Chapter 10 175-205pp.

Dwire, K. A. Kauffman J.B. 2003. Fire and riparian ecosystems in landscapes of the western USA. Forest Ecology and Management. 178 (1-2): 61-74.

Department of Water Resources, 2007. Climate change in California. http://www.water.ca.gov/climatechange/docs/062807factsheet.pdf (1 January 2015).

Elliot, W.J., Miller, I.S., Audin, L., Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Elmore, W., Beschta, R. L. 1987. Riparian areas; perceptions in management. Rangelands 9(6), December 1987, 260-265pp.

Engelhardt, B., Tuitele-Lewis, J. Clines. J..M. 2014. French Fire – Botanical Resources BAER (Burned Area Emergency Response) Report. USDA Forest Service unpublished report, available project record and in files of Forest Botanist, Sierra National Forest, North Fork, CA.

Environmental Protection Agency, [n.d.] Compilation of air pollutant emission factors, Volume 1: Stationary Point and Area Sources. Fifth Edition. AP-42

Environmental Protection Agency, 1991. Monitoring guidelines to evaluate effects of forestry activities on streams in the Pacific Northwest and Alaska. Center for Streamside Studies in Forestry, Fisheries and Wildlife, College of Forest Resources/College of Ocean and Fishery Sciences, University of Washington, Seattle, Washington.

Ewell, C. 2014. 2013 Aspen Fire Sierra National Forest; Fire behavior Assessment Team Summary Report (Draft). Adaptive Management Services Team.31p. [Unpublished].

Fellers, G.M., Freel. K.L. 1995. A Standardized protocol for surveying aquatic amphibians. Technical Report NPS/WRUC/NRTR-01. United States Department of the Interior. National Park Service. Western Region, National Biological Service, Cooperative Park Studies Unit. The University of California, Davis, California.

Ferguson, L.R.; Baguley, B.C. 1988. Verapamil as a co-mutagen in the Salmonella/mammalian microsome mutagenicity test. Mutat. Res. 209: 57-62.

Ferrell, G.T. 1978. Moisture stress threshold of susceptibility to fir engraver beetles in pole-size white firs. Forest science, 24(1), 85-92.

Ferrell, G.T. 1996. The influence of insect pests and pathogens in Sierra forests.. In: Sierra Nevada Ecosystem Project: Final Report to Congress, Assessments and scientific basis for management options. Vol. II Ch. 21. Univ. of Calif. Centers for Water and Wildland Resources, Davis, CA 95616. 1177p.

Fettig, C.J., Klezpig, K.D., Billings, R. F., Munson, A.S. Nebeker, T.E., Negron, J.F., Nowak., J.T. 2007. The effectiveness of vegetation management practices for prevention and control of bark beetle infestations in coniferous forests of the Western and Southern United States. Forest Ecology and Management. 238: 24-53.

Fiske, J.N. 1981. Evaluating the need for release from competition from woody plants to improve conifer growth rates. In: Proceedings, third annual forest vegetation management conference, November, 4-5, Redding, CA: Forest Vegetation Management Conference. 24-54pp.

Fites-Kaufman, J., Bradley, A.F., Merrill A.G. 2006. Fire and plant interactions. In: Fire in California's Ecosystems. Berkeley: University of California Press. Ch. 6, 94-117pp.

Forsman, E.D., Meslow, E.C., Wight,H.M.. 1984. Distribution and biology of the spotted owl in Oregon. Wildlife Monograph 87. 64 pp.

Fowells, H.A., Schubert, G.H. 1956. Seed crops of forest trees in the pine region of California. U. S. Dep. Agric. Tech. Bull. 1150, 48p.

Franklin, A.B.; Anderson, D.R.; Gutiérrez, R.J.; Burnham, K.P. 2000. Climate, habitat quality, and fitness in northern spotted owl populations in northwestern California. Ecological Monographs. 70(4): 539–590.

Franklin, J., Bergman, E. 2011. Patterns of pine regeneration following a large severe wildfire in the mountains of southern California. Canadian Journal of Forest Research, 41, 810-821pp.

Franklin, J.F., Agee, J.K.. 2003. Forging a science-based national forest fire policy. Issues in Science and Technology. Fall 2003.

Freel, M. 1991. A literature review for management of the marten and fisher on national forests in California. USDA. Forest Service, Pacific Southwest Region. Cover letter to Forests is dated 1992.

Furniss, M.J., Roelofs, T. D., Yee and C. S, 1991. Road construction and maintenance. In: Influences of forest and rangeland management on salmonid fishes and their habitats. Chapter 8. American Fisheries Society special publication 19. 721 pp.

Gaines, W.L.; Harrod, R.J.; Dickinson, J.; Lyons, A.L.; Halupka, K. 2010. Integration of Northern spotted owl habitat and fuels treatments in the eastern Cascades, Washington, USA. Forest Ecology and Management. 260(11): 2045–2052

Gerish, F.M. 1984. Evaluation of a static renewal chronic toxicity test method for D. magna using boric acid. Environmental Toxicology and Chemistry 3:1, 89-94.

Ghassemi, M., Fargo, L., Painter, P., Painter, P., Quinlivan, S., Scofield, R., Takata, A.M. 1981. Environmental fates and impacts of major Forest use pesticides. EPA Contract No. 68-02-3174, U.S. Environmental Protection Agency, Office of Pesticides and Toxic Substances, Washington, D.C. 310 p.

Giesy, J. P., Dobson,S., Solomon, K. R. 2000. Eco toxicological risk assessment for Roundup herbicide. Review of contamination and toxicology 167:35–120. In Relyea, R. A. 2005. The lethal impacts of roundup on aquatic and terrestrial amphibians. Ecological Applications, 15(4), 2005, 1118–1124pp.

Gould, A.D. 2015. Forest Supervisor. Sierra National Forest. Yellow legged frog buffer decision, March 18, 2015.

Graber, D.M. 1996. “Status of terrestrial vertebrates.” In Sierra Nevada Ecosystem Project, Final Report to Congress, volume II Chapter 25. Assessments and scientific basis for management options. Davis: University of California, Centers for Water and Wildland Resources. 26p.

Gray, A.N., Zald, H.S.J., Kern, R.A., North, M. 2005. Stand conditions associated with tree regeneration in Sierran mixed-conifer forests. Forest Science. 51(3): 198-210.

Grinnell, J., Dixon, J.S., Linsdale, L.M. 1937. Furbearing mammals of California: their natural history, systematic status and relations to man. University of California, Berkeley, 1:1-77.

Guarin, A, Taylor A.H. 2005. Drought triggered tree mortality in mixed conifer forests in Yosemite National Park, California, USA. Forest Ecology and Management 218: 229–244.

Gucinski, H.,.Furniss, M. J.,. Ziemer, R.R., Brookes, M.H. eds. 2001. Forest roads: a synthesis of scientific information. PNW-GTR-509. Pacific Northwest Research Station, Portland, OR. 103p.

Gutierrez, R.J., Verner, J., McKelvey,K.S., Noon, R.B., Steger, G.N., Call, D.R., LaHaye, W.S., B. Bingham, B., Senser, J.S. 1992. Chapter 5. Habitat Relations of the California Spotted Owl in USDA Forest Service Gen Tch Rep. PSW-GTR-133.

Guyton, K.Z., et al. 2015. Carcinogenicity of tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate. Lancet Oncology. Published online March 20, 2015. http://www.thelancet.com/pdfs/journals/lanonc/PIIS1470-2045%2815%2970134-8.pdf. (15 April 15).

Hall, C.L.; Hamilton P.B. 1982. In vitro antifungal activity of Gentian Violet. Poult. Sci. 61(1): 62- 66.

Hall, R.J., Henry, P.F.P. 1992. Assessing effects of pesticides on amphibians and reptiles: Status and needs. HERPETOL. J. Vol. 2, no. 3, 65-71pp.

Halton, D.M. 1983. Occupational exposures fromsSpirit duplicator operations. Canadian Centre for Occupational Health and Safety, Ontario, Canada. CCOHS Report No. P84-2E. 11p.Hamilton SJ. 1995. Hazard assessments of inorganics to three endangered fish in the Green River, Utah. Eco toxicology and Environmental Safety. 30:134-142.

Hanson, C.T. 2013. Habitat use of Pacific Fishers in a heterogeneous post-fire and unburned forest landscape on the Kern Plateau, Sierra Nevada, California. The Open Forest Science Journal, 6. 24-30pp.

Hanson, C. T. 2010. The myth of "catastrophic" wildfire: a new ecological paradigm of forest health. John Muir Project Technical Report 1. John Muir Project of Earth Island Institute, Cedar Ridge, California.

Hanson, C. T.; North, M. P. 2009. Post-fire survival and flushing in three Sierra Nevada conifers with high initial crown scorch. International Journal of Wildand Fire 18: 857-864.

Harrell, R.D., 1978. California regional supplement to handbook for predicting slash weights of western conifers. Gen Tech Rep. INT-37. US Department of Agriculture, Forest Service. 12p.

Harris, G.A., Goebel, C.J.. 1976. Factors of plant competition in seeding Pacific Northwest Bunchgrass ranges. Bulletin – College of agriculture research center. Washington State University, No. 820.

Hayes T.B., Collins A., Lee M., Mendoza M., Noriega N., Stuart A., Vonk, A. 2002. Hermaphroditic, demasculinized frogs after exposure to the herbicide atrazine at low ecologically relevant doses. Proc Nat'l Acad Sci 99: 5476-5480. In Cauble K. and R. S. Wagner. 2004. Sublethal Effects of the Herbicide Glyphosate on Amphibian Metamorphosis and Development. Bull. Environ. Contam. Toxicol. (2005) 75:429–435 Page 103 of 128 Aquatic Species Biological Assessment and Evaluation for the Soaproot Project 2012 Sierra National Forest, High Sierra Ranger District.

Heffner, K. 1997. Water quality effects of three dust abatement compounds. USDA FS Engineering Field Notes, 29:35-43.

Henny, C.J., Beal, K.F., Bury, R.B., Goggans, R.. 2003. Organochlorine Pesticides, PCBs, Trace elements and metals in Western Pond Turtle eggs from Oregon. Northwest Science, Vol. 77, No. 1 46-53pp.

Hermanson, J.W., O'Shea, T.J. 1983. Antrozous pallidus. American Society of Mammalogists, Mammalian Species, 213:1-8.

Hilton, S., Lisle,T.E.,. 1993. Measuring the fraction of pool volume filled with fine sediment. Research Note PSW-RN-414-WEB. Pacific Southwest Research Station, Albany, CA. 11p.

Hironaka, M. 1961. The relative rate of root development of cheatgrass and medusahead. J. of Range Management. 14:263-67.

Hoag, S.G., Steiner, J.F. 1983. Vaginitis: Prevention and treatment. US Pharm. 8: 43-48

Hoffman, C.F.; Sieg, C.H.; McMillin, J.D., Fule, P.Z. 2012. Fuel loading 5 years after a bark beetle outbreak in south-western USA ponderosa pine forests. International Journal of Wildland Fire 2012, 21, 306-312.

Hood, S.M.; Smith, S.L.; Cluck, D.R. 2007. Delayed conifer tree mortality following fire in California. In: Powers, R. F., tech. editor. Restoring fire-adapted ecosystems: proceddings of the 2005 national silviculture workshop. Gen. Tech. Rep. PSW-GTR-203, Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Dept. of Agriculture: p. 261-283.

Hossack, B.R., Pilliod, D.S. 2011. Amphibian responses to wildfire in the western United States- Emerging patterns from short-term studies: Fire Ecology, v. 7, no. 2,. 129-144pp. Catalog No: 2250.

Houlahan, J.E., Findlay, C.S. 2003. The effects of adjacent land use on wetland amphibian species richness and community composition. Canadian Journal of Fisheries and Aquatic Sciences.60: 1078-1094. In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Information Ventures, Inc. 1994-2005. Glyphosate, Pesticide Fact Sheet, Prepared for the U.S. Department of Agriculture, Forest Service.

IPCC. 2007. Field, C.B., Barros, V., Stocker, T. F., Qin, D., Dokken, D.J., Ebi, K.L.,. Mastrandrea,M.D., Mach,K.J., Plattner,G.K., Allen, S.K., Tignor, M., Midgley, P.M.,(Eds.), Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 8RU ENGLAND, 582 pp.

Irwin, L.L.; Fleming, T.L.; Beebe, J. 2004. Are spotted owl populations sustainable in fire-prone forests? Journal of Sustainable Forestry. 18(4): 1–28.

Jain, T.B. Graham, R.T. 2004. Is forest structure related to fire severity? Yes, no, and maybe: methods and insights in quantifying the answer. USDA Forest Service Proceedings RMRS-P-34. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 49-63pp.

Jenkins, M. J., Runyon, J. B., Fettig, C. J., Page, W. G., Bentz, B. J. 2014. Interactions among the mountain pine beetle, fires, and fuels. Forest Science, 1.

Jenkins, M. J., Runyon, J. B., Fettig, C. J., Page, W. G., Bentz, B. J. 2013. Interactions among the mountain pine beetle, fires, and fuels. Forest Science, 1.

Jennings, M. R. Hayes, M.P. 1994. Amphibian and reptile species of special concern in California. Final report submitted to the California Department of Fish and Game, Inland Fisheries Division, Contract No. 8023. Sacramento, CA. 25 pp.

Johnson, M.C.; Halofsky, J.E., Peterson, D.L. 2013. Effects of salvage logging and pile-and-burn on fuel loading, potential fire behavior, fuel consumption and emissions. International Journal of Wildland Fire. 2013, 22:757-769.

Johnson, M.C.; Kennedy, M.C., Peterson, D.L. 2011. Simulating fuel treatment effects in dry forests of the western United States: testing the principles of a fire-safe forest. Canadian Journal of Forest Research 41:1018-1030.

Jones, J.A., Grant, G.E. 1996. Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Oregon. Water Resources Research, 32(4):959-974.

Jones, J.L..Garton, E.O. 1994. Selection of successional stages by fishers in northcentral Idaho. In S.W. Buskirk et.al. (eds.)

Kagarise Sherman, C. Morton, M. L. 1993. Population declines of Yosemite toads in the eastern Sierra Nevada of California. Journal of Herpetology, 27:186-198.

Karr, J.R., J.J. Rhodes, G.W. Minshall, F.R. Hauer, R.L. Beschta, C.A. Frissell, and D.A. Perry. 2004. The effects of postfire salvage logging on aquatic ecosystems in the American west. BioScience, 54(11): 1029-1033.

Kattelmann, R. 1996. Hydrology and water resources. In: Sierra Nevada Ecosystem Project: Final report to Congress, vol. II, chapter 30. Davis: University of California, Centers for Water and Wildland Resources. Page 104 of 128 Aquatic Species Biological Assessment and Evaluation for the Soaproot Project 2012 Sierra National Forest, High Sierra Ranger District .

Keane, J.J. 2014. California spotted owl: scientific considerations for forest planning. In: Long, J.W.; Quinn-Davidson, L.; Skinner, C.N., eds. Science synthesis to support socioecological resilience in the Sierra Nevada and southern Cascade Range. Gen. Tech. Rep. PSW-GTR-247. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 437-467. Chap. 7.2

Keeley, J.E. 2001. Fire And invasive species in Mediterranean-climate ecosystems of California. pp 81- 94 In K.E. Galley and T.P. Wilson, editors. Proceedings of the invasive species work shop: The role of fire in the control and spread of invasive species. Miscellaneous Publication No. ll. Tall Timbers Research Station, Tallahassee, Florida

Keeley, J.E., Fotheringham and C.J. 1998. Smoke-induced seed germination in the California chaparral. Ecology,Vol. 79, No. 7 (Oct., 1998), 2320-2336pp.

Keyser, T.L.; Lentile, L.B.; Smith, F.W., Shepperd W.D. 2007. Changes in forest structure after a large mixed-severity wildfire in ponderosa pine forest of the Black Hills, South Dakota, USA. Forest Science 54 (3) 11p.

Kie, J. G. 1985. Production of deer brush and mountain whitethorn related to shrub volume and overstory crown closure. PSW-377. Berkeley, CA. U. S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station. 3p.

Kilgore, B.M. 1973. The ecological role of fire in Sierran conifer forests. Quaternary Research. 3: 496- 513.

Knopf, F.L. 1986. Changing landscapes and the cosmopolitanism of the eastern Coloradoavifauna. Wildlife Society Bulletin. 14: 132-142. In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Knopf, F.L.;, Johnson, R.R., Rich, T., Samson, F.B., Szaro, R.C. 1988. Conservation of riparian systems in the United States. Wilson Bulletin. 100: 272-284. In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Knowles, S., Choudhury T.; Shear N.H. 1994. Metronidazole hypersensitivity. Ann. Pharmacother. 28: 325-326.

Korte, MacDonald. 2005. Road Sediment Production and Delivery in the Southern Sierra Nevada, California. American Geophysical Union, Fall Meeting 2005, abstract #H51E-0416. http://adsabs.harvard.edu/abs/2005AGUFM.H51E0416K (29 July 2015).

Kozlowski, T.T. 2002. Physiological ecology of natural regeneration of harvested and disturbed forest stands: implications for forest management. Forest Ecology and Management 158 (2002) 195- 221.

Krishnaja, A.P; Sharma N.K. 1995. Heterogenicity in chemical mutagen-in damage after G2 phase exposur to bleomycin, ara-C and Gentian Violet in cultured lymphocytes of beta thalassaemia traits. Mutat. Res. 331(1): 143-148.

Kroll, A.J.; Fleming, T.L.; Irwin, L.L. 2010. Site occupancy dynamics of northern spotted owls in the eastern Cascades, Washington, USA. The Journal of Wildlife Management. 74(6): 1264-1274.

LaHaye, W.S., Gutiérrez, R.J., Call, D.R. 1992. Demography of an insular population of spotted owls (Strix occidentalis occidentalis).. in Proceedings of Wildlife 2001: Populations (D.R. McCollough and R.H. Barrett, editors). Elsevier Applied Science, London and New York, New York. 803–814pp.

Lalande, R., Furlan, V., Angers, D.A., Lemieux, G. 1998. Soil improvement following addition of chipped wood from twigs. American Journal of Alternative Agriculture 13: 132-137. In Dwire , K.A, Rhoades, C.C., Young, M.K. 2010. Potential effects of fuel management activities on riparian areas. Gen. Tech. Rep. RMRS-GTR-231, Department of Agriculture, Forest Service, Rocky Mountain Research Station. Chapter 10, 175-205. 2010pp.

Lannoo, M. 2005. Amphibian declines: the conservation status of United States Species, Berkeley, CA. University of California Press.

Larsen I.J., Pietraszek J.H., Libohova Z. et al. 2009. Causes of post-fire runoff and erosion: Water repellency, cover or soil sealing?. Soil Sci Soc Am J. 2009. 73:1393-407.

Larsen, Isaac J., MacDonald, L.H., Brown, E., Rough, D., Welsh, M.J.,. Pietraszek J.H, Libohova, Z., J. de Dios Benavides-Solorio, J.,. Schaffrath, K. 2009. Causes of post-

fire runoff and erosion: water repellency, cover, or soil sealing? Soil Sci. Soc. Am. J., 73(4): 1393-1407.

Larson, M. M., Schuber, G. H. 1969. Root competition between ponderosa pine seedlings and grass. USDA Forest Service, Research Paper RM-RP-54. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 12 p.

Laymon, S.A. 1988. The ecology of the spotted owl in the central Sierra Nevada, California. Berkeley: University of California; Dissertation.285 p.

Lee, D.C.; Irwin, L.L. 2005. Assessing risks to spotted owls from forest thinning in fire-adapted forests of the western United States. Forest Ecology and Management. 211: 191–20.9

Lewis, J., Mori, S.R., Keppeler, E.T., Ziemer,, R.R 2001. Impacts of logging on storm peak flows, flow volumes, and suspended sediment loads in Caspar Creek, California. In: M.S. Wigmosta and S.J. Burges, eds., Land use and watersheds: human influence on hydrology and geomorphology in urban and forest areas. Water Science and Application Volume 2,. American Geophysical Union, Washington, D.C. 85-125pp.

Liang, C. T. 2010. Habitat modeling and movements of the Yosemite toad (Anaxyrus (=Bufo) canorus) is the Sierra Nevada, California. IN Press: Dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy in the Ecology in the Ecology in the Office of Graduate Studies of the University of California, Davis.

Lindenmayer, D.B., Noss, R.F. 2006. Salvage logging, ecosystem processes, and biodiversity conservation. Conservation Biology Volume 20, No. 4, 949-958.

Liskey, E.N. 1993. Effects of disturbance on *Collomia rawsoniana*. Unpubl. MA Thesis. California State University, Fresno, California.

Littlefield N.A.; Blakcwell B.N.; Hewitt C.C.; Gaylor D.W. 1985. Chronic toxicity and carcinogenicity studies of Gentian Violet in mice. Fund. Appl. Toxicol. 5(5): 902-912.

Littlefield N.A.; Gaylor D.W.; Blackwell B.N.; Allen R.R.. 1989. Chronic toxicity /studies of Gentian Violet in Fischer 344 rats: Two-generation exposure. Food Chem. Toxicol. 27(4): 239-247Lisle, T.E., and S. Hilton. 1999. Fine bed material in pools of natural gravel bed channels. Water Resources Research, 35(4): 1291-1304.

Lofroth, E.C., Raley, C.R., Higley, J.M., Truex, R.L., Yaeger, J.S., Lewis JC, Happe, P.J., Finely ,L.L, Naney, R.H., Hale ,L.J., Kraus, A.L., Livingston , S.A, Myers, A.M., Brown, R.N.. 2010. Conservation assessment for fisher (Martes Pennanti) in souther-central British Columbia, western Washington, western Oregon, and California. Volume 1. Denver: U.S. Department of the Interior Bureau of Land Management. http://www.fws.gov/yreka/PDF/Lofroth_etal_2010.pdf (29 July 2015).

Lowe, T. 1994. Fugitive dust analysis for timber haul on unpaved roads, Sierra National Forest. 6p.

Luce, C.H., Black., T.A. 1999. Sediment production from forest roads in western Oregon.Water Resources Research 35(8):2561-2570.

MacDonald, L.H., Coe, D., Litschert, S. 2004. Assessing cumulative watershed effects in the Central Sierra Nevada: hillslope measurements and catchment-scale modeling. Proceedings, Sierra Nevada Science Symposium, October 7-10, 2002, Kings Beach, CA. PSW-GTR-193: 149-157.

MacDonald, L.H., Stednick, J.D. 2003. Forests and water: a state-of-the art review for Colorado. CWRRI Completion Report No. 196. Colorado State University, Fort Collins, CO.

Maier K.J.; Knight, A.W. 1991. The toxicity of waterborne boron to D. magna and C. decorus and the effect of water hardness and sulfate on boron toxicity. Arch Environ Contam Toxicol 20:282- 287.

Mallek, C., Safford, H., Viers, J., Miller, J. 2013. Modern departures in fire severity and area vary by forest type, Sierra Nevada and southern Cascades, California, USA. Ecosphere, 4(12), art153.

Manley, P. Personal Communication. PSW Research Wildlife Ecologist, Region 5.

Mantgem, P. J., Nesmith, J. C., Keifer, M., Knapp, E. E., Flint, A., Flint, L. 2013. Climatic stress increases forest fire severity across the western United States. Ecology letters, 16(9), 1151- 1156.

Martin, D. L. 2008. Decline, movement and habitat utilization of the Yosemite toad (Bufo canorus): an endangered anuran endemic to the Sierra Nevada of California. A Dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy in Ecology, Evolution and Marine Biology. University of California at Santa Barbara. 406 pp.

Martin, D. L. 1992. Sierra Nevada Anuran Guide. Canorus Ltd. Ecological Research Team. Canorus Ltd. Press. San Jose. 28 pp.

Martin, D.2014. District Ranger. Sierra National Forest, Bass Lake Ranger District. 100 foot no treatment area as the Streamside Management Zone. November 17, 2014.

Maxell, B., Hokit, G. 1999. Amphibians and reptiles, 2.1-2.29pp. In G. Joslin and H.Youmans, coordinators. effects of recreation on Rocky Mountain wildlife: a review of Montana. Committee on effects of recreation on Wwildlife, Montana Chapter of the Wildlife Society. 307pp.

Maxwell, W.G.; Ward, F. R. 1980. Photo series for quantifying natural forest residues in common vegetation types of the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-105. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 229 p. http://www.fs.fed.us/pnw/publications/pnw_gtr105.

Mayer, K., Laudenslayer, W.F Jr. 1988. A guide to wildlife habitats of California. California Department of Fish and Game, Sacramento, California. 166 p.

McComb, W.C.; McGrath, M.T.; Spies, T.A.; Vesely, D. 2002. Models for mapping potential habitat at landscape scales: an example using northern spotted owls. Forest Science. 48(2): 203 216.

McDonald, P.M., Fiddler, G. O. 2010. Twenty-five years of managing vegetation in conifer plantations in northern and central California: results, application, principles, and challenges.

McDonald, P.M., Fiddler,G.O., Potter, D. A,. 2004. Ecology and manipulation of bearclover (Chamaebatia foliolosa) in northern and central California: The status of our knowledge. Gen. Tech. Rep. PSW-GTR-190. Albany, CA: U. S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 26 p.

McDonald, P.M., Fiddler. G. O 2001. Timing and duration of release treatments affect vegetation development in a young California white fir plantation. Research Paper. PSW-RP-246. Albany, CA: U. S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 14 p.

McDonald, P.M., Fiddler. G. O. 1999. Recovery of a Bearclover (Chamaebatis Foliolosa) Plant Community after Site Preparation and Planting of Ponderosa Pine Seedlings. Research Note. PSW-RN-423. Albany, CA: U. S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 8 p.

McDonald, P.M., Abbot, C. S, 1997. Vegetation trends in a 31-year-old ponderosa pine plantation: effect of different shrub densities. Research Paper. PSW-RP-231. Albany, CA: U. S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 35 p.

McDonald, P.M., Fiddler. G. O. 1997. Mechanical and chemical release in a 12-year-old ponderosa pine plantation. Research Paper. PSW-RP-232. U. S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 12 p.

McDonald, P.M., Fiddler. G. O 1997b. Timing and duration of release treatments affect vegetation development in a young California red fir plantation. General Technical Report .PSW-GTR-233 Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 14 p.

McDonald, P.M., Everest, G. A. 1996. Response of young ponderosa pines, shrubs, and grasses to two release treatments. Research Note. PSW-RN-419. Albany, CA: U. S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station 7 p.

McDonald, P.M., Fiddler. G. O. 1995. Development of a mixed-shrub-ponderosa pine community in a natural and treated condition. Research Paper. PSW-RP-224. Albany, CA: U. S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 19 p.

McDonald, P.M., Fiddler. G. O. 1990. Ponderosa pine seedlings and competing vegetation: ecology, growth, and cost. Research Paper. PSW-RP-199. Albany, CA: U. S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 10 p.

McDonald, P.M., Fiddler. G. O. 1989. Competing vegetation in ponderosa pine plantations: ecology and control. General Technical Report. PSW-GTR-113. Albany, CA: U. S.

Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station; 26 p.

McDonald, P.M. 1986. Grasses in Young Conifer Plantations-Hindrance and Help. Northwest Science60(4)

McGinnis, T.W., Keeley, J.E. Stephens, S.L. Roller, G.B. 2010. Fuel buildup and potential fire behavior after stand-replacing fires, logging fire-killed trees and herbicide shrub removal in Sierra Nevada forests. Forest Ecology and Management 260:22-35.

Mchugh, C.W., Kolb, T. E. Wilson, J. L. 2003. Bark beetle attacks on ponderosa pine following fire in Northern Arizona. Population Ecology, 32(3): 510-522.

McIver, J.D.; Ottmar, R. 2006. Fuel mass and stand structure after post-fire logging on a severely burned ponderosa pine forest in northeastern Oregon. Forest Ecology and Management 238 (2007) 268-279.

McMahon, T. E., and D. S. deCalesta. 1990. Effects of fire on fish and wildlife. Pages 233–250 in J. D. Walstad, S. R. Radosevich, and D. V. Sandberg, editors. Natural and prescribed fire in Pacific Northwest forests. Oregon State University Press, Corvallis. Page 105 of 128 Aquatic Species Biological Assessment and Evaluation for the Soaproot Project 2012 Sierra National Forest, High Sierra Ranger District.

Meddens, A.J., Hicke, J.A., Ferguson, C.A. 2012. Spatiotemporal patterns of observed bark beetle- caused tree mortality in British Columbia and the western United States. Ecological Applications, 22(7), 1876-1891.

Meehan, W.R. 1991. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society special publication 19. 721 pp.

Megahan, W.F. 1991. Erosion and site productivity in Western-montane forest ecosystems. Symposium on Management and Productivity on Western-Montane Forest Soils, Boise, ID, April 10-12, 1990. Gen. Tech. Rep. INT-280. U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 146-150pp.

Menke, J.W., C. Davis, Beesley, P. 1996. Rangeland assessment. In: Sierra Nevada Ecosystem Project: Final report to Congress, Vol. III, chapter 22. Davis: University of California, Centers for Water and Wildland Resources.

Meyer, M. Safford, H., Sawyer, S. 2012. A summary of current trends and probable future trends in climate and climate-driven processes in the Sierra National Forest and neighboring Sierra Nevada. Unpublished. 30pps.Meyer, M.D., M.P. North, and S.L. Roberts. 2008. Truffle abundance in recently prescribed burned and unburned forests of Yosemite National Park: Implications for mycophagous mammals. Fire Ecology 4:105-114.

Meyer, M., Safford, H.. 2010. A summary of current trends and probable future trends in climate and climate-driven processes in the Sierra National Forest and neighboring Sierra Nevada. [Unpublished]. 20pp.

Meyer, W.H. 1938 (slightly revised April 1961).Yield of even-aged stands of Ponderosa Pine. Technical Bulletin No. 630, U.S. Department of Agriculture, Washington, D.C.

Meyers, T.J., Swanson, S. 1992. Variation of stream stability with stream type and livestock bank damage in Northern Nevada. Water Resources Bull. AWRA, 28(4): 743-754.

Millar, C.I.,Woolfenden, W.B. 1999. The role of climatic change in interpreting historic variability. Ecological Applications 9 [4]:1207-1216.

Miller, H. C., D. Clausnitzer, and M. M. Borman. 1999.Medusahead. 271–281pp. In. Sheley, R.L. Petroff, J.K . eds. Biology and Management of Noxious Range Weeds Corvallis, OR Oregon State University Press.

Miller J.D., B.M., Collins, J.A. Lutz, S.L., Stephens, J.W., Van Wagtendonk, D.A. Yasuda. 2012c. Differences in wildfires among ecoregions and land management agencies in the Sierra Nevada region. California. USA. Ecosphere 3: article 80.

Miller, J.D., Safford, H. 2012. Trends in wildfire severity: 1984 to 2010 in the Sierra Nevada, Modoc Plateau, and southern Cascades, California, USA. Fire Ecology 8(3): 41-57.doi: 10.4996/fireecology.0803041.

Miller, J. D.,. Safford, H. D., Crimmins, M. A., Thode, A. E. 2009. Quantitative evidence for increasing forest fire severity in the Sierra Nevada and southern Cascade Mountains, California and Nevada, USA. Ecosystems. 12: 16-32.

Miller, J. D., Safford,H. D. 2008. Sierra Nevada fire severity monitoring: 1984-2000. Technical Paper. R5- TP-027. Vallejo, CA, Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 102 p.

Miller, J. D., Thode, A.E. 2007. Quantifying burn severity in a heterogeneous landscape with a relative version of the delta Normalized Burn Ratio (dNBR). Remote Sensing of Environment, 109(1), 66-80.

Miller, J. M., Keen, F. P. 1960. Biology and control of the western pine beetle. Misc. Publ. 800.Washington, DC: U.S. Department of Agriculture; 381 p.

Minshall, G.W., Brock, J.T., Varley, J.D 1989. Wildfires and Yellowstone's Stream Ecosystems. A temporal perspective shows that aquatic recovery parallels forest succession. BioScience Vo. 39 No. 10 pp 707-715.

Moghaddas, E.Y., Stephens, S.L. 2008. Mechanized fuel treatment effects on soil compaction in Sierra Nevada mixed-conifer stands. Forest Ecology and Management 255 (2008) 3098-3106.

Monsanto, P. G., Agee, J.K. 2008. Long-term post-wildfire dynamics of coarse woody debris after salvage logging and implications for soil heating in dry forests of the eastern Cascades, Washington. Forest Ecology and Management 255 (2008) 3952-3961.

Moyle, P. B. 2002. Inland fish of California, revised and expanded. University of California Press, Berkeley and Los Angeles, CA. 502 pp.

Murphy, A.H., Turner, D. 1959. A study on the germination of medusahead seed. Calif. Dept. of Agriculture Bull., 48(1): 6-10.

Myers, J.R., Fosbroke, D.E. 1995. The Occupational Safety and Health Administration logging standard: What it means for forest managers. Journal of forestry (USA).

Nagel, R. 1995. Gentian Violet use. P&T. 20 (August): 550pp.

National Oceanic and Atmospheric Administration. 2015. Drought Monitor, (January 2015). http://www.drought.gov/drought (29 July 2015).

Neary, D.G., Landsberg, J.D., Tiedeman, A.R., Folliot, P.F. 2005. Chapter 6: water quality. IN: Wildland Fire in Ecosystems, Effects of Fire on Soil and Water. USDA - Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-42-volume 4. pp. 119-134.

Neary, D.G.,. Folliott, P.,. Landsberg, J.D. 2005. Fire and streamflow regimes. Chapter 5 in: Neary, D.G., K.C. Ryan, and L.F. DeBano, eds., Wildland fire in ecosystems: effects of fire on soil and water. RMRS-GTR-42-vol 4. USDA Forest Service Rocky Mountain Research Station, Fort Collins, CO. 250p.

Nevada, Modoc Plateau, and Southern Cascades, California, USA. Fire Ecology 8(3): 41-57.doi: 10.4996/fireecology.0803041

Norris, Vol. 1993. The use of buffer zones to protect water quality: a review. Water Resources Management, vol. 7. (p. 257-272): Kluwer Academic Publishers, Netherlands.

North, M., Hurteau,M., Fiegener, R., Barbour, M.. 2005. Influence of fire and El Ninõ on tree recruitment varies by species in Sierran mixed conifer. Forest Science. 51(3): 187-197.

North, M.,P. Stine, O'Hara, K., Zielinski, W., Stephens, S. 2009. An ecosystem management strategy for Sierran mixed-conifer forests. General Technical Report. PSW-GTR-220. Albany, CA: U. S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station. 49 p.

Noss, R.,J. Franklin, Baker,W., Schoen-nagel, T. 2006. Managing fire-prone forests in the western United States. Frontiers in Ecology and the Environment 4:481-487.

Novak, M., Baker, Obbard, M.E., Malloch, B. eds. Ontario Ministry of Natural Resources, Canada. 150 pp.

O'Farrell, M.J., Studier, E.H.. 1980. Myotis thysanodes. American Society of Mammalogists, Mammalian Species, 137:1-6.

O'Farrell, M.J., Studier, E.H. 1973. Reproduction, growth and development in Myotis thysanodes and Myotis lucifugus (Chiroptera: Vespertilionidae) Ecology 54(1):18-30.

Oblinger, B., Fischer, L., Heath, Z., Moore, J. 2011. Can any recent trends involving drought severity and bark beetles be attributed to tree mortality in California? Forestry Source, pgs 12 & 15.

Odion, D.C., Hanson, C.T., Arsenault, A., Baker, W.L., DellaSala, D.A., Hutto, R.L., Williams, M.A. 2014. Examining historical and current mixed-severity fire regimes in ponderosa pine and mixed-conifer forests of Western North America. PloS one, 9(2), e87852.

Odion, D., Frost, E. J., Strittholt, J. R., Jiang, J., Dellasala, D. A., Mortz, M. A 2004. Patterns of fire severity and forest conditions in the Western Klamath Mountains, Cal. ifornia. Conservation Biology. 18(4): 927-936pp.

Office of the Federal Register, National Archives and Records Administration, Vol. 77, No. 171 / Tuesday, September 4, 2012, p. 53834-53838, Washington, DC 20408: http://www.gpo.gov/fdsys/pkg/FR-2012-09-04/pdf/FR-2012-09-04.pdf (29 July 2015).

Oliver, W.W. 1995. Is self-thinning of ponderosa pine ruled by Dendroctonus bark beetles? P. 213-218. General Technical Review. RM-GTR-267. Fort Collins, CO. U. S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 5 p.

Oliver, W.W. 1990. Spacing and shrub competition influence 20-year development of planted ponderosa pine. Western Journal of Applied Forestry. 5(3): 79-82.

Oliver, W.W. 1979. Fifteen-year growth patterns after thinning a ponderosa-Jeffery pine plantation in northeastern, California. Research paper. PSW-RP-141. Berkeley, CA: U. S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station. 10 p.

Oliver, W.W., Uzoh, F.. 2002. Little response of true fir saplings to understory shrub removal. Western Journal Of Applied Forestry. 17(1): 5-8.

Olson, D.H., Anderson, P.D., Frissell, C.A., Welsh, H.H.,. Bradford, D.F. 2007. Biodiversity management approaches for stream-riparian areas: Perspective for Pacific Northwest headwater forests, microclimates, and amphibians. Forest Ecology and Management 426 (2007) 81-107.

Olson, D.H., Chan, S.S.,. Thompson. C.R. 2002. Riparian buffers and thinning designs in western Oregon headwaters accomplish multiple resource objectives. In: Johnson, A.C.; Haynes,R.W.; Monserud, R.A. [Eds.]. Congruent Management of Multiple Resources: Proceedingsfrom the Wood Compatibility Workshop; December 5-7, 2001, Skamania Lodge, Stevenson,WA. PNW- GTR-563. USDA Forest Service. Pacific Northwest Research Station. Portland,OR: 81-91. In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Olson, G.S.; Glenn, E.M.; Anthony, R.G.; Forsman, E.D.; Reid, J.A.; Loschl, P.J.; Ripple, W.J. 2004. Modeling demographic performance of northern spotted owls relative to forest habitat in Oregon. The Journal of Wildlife Management. 68(4): 1039–1053.

Omi, P.N., Martinson, E.J. 2002. Final Report: Effects of Fuels Treatments on Wildfire Severity. Fort Collins, CO: Western Forest Research Center, Joint Fire Sciences Program, Colorado State University.

Orr, R.T. 1954. Natural history of the pallid bat, Antrozous pallidus (LeConte). Proceedings of the California Academy of Sciences, 28:165-246.

O'Shea, T.J., Vaughan, T.A.. 1977. Nocturnal and seasonal activities of the pallid bat, Antrozous pallidus. Journal of Mammalogy 58: 269-284.

Otto, A.B. 2015. French Fire Recovery and Restoration Project – Biological Evaluation. Sierra National Forest. Open file report. On file at the Bass Lake Ranger District, North Fork, CA.

Otto, A.B. 2014. Aspen Project Black Backed woodpecker Management Indicator Report.

Perkins, D.W., Hunter, M.L. 2006. Effects of Riparian Timber Management on Amphibians in Maine. Journal of Wildlife Management, 70(3):657-670. 2006

Peterson, D.W., Dodson, E.K., Harrod, R.J. 2015. Post-fire logging reduces surface woody fuels up to four decades following wildfire. Forest Ecology and Management, 338, 84-91.

Peterson, D.L.; Agee, J.K.; Aplet, G.H.; Dykstra, DP.; Graham, R.T.; Lehmkuhl, J.F.; Pilliod, D.S., Potts, DF.; Powers, R.F.; Stuart, J.D. 2009. Effects of timber harvest following wildfire in western North America. Gen. Tech. Rep. PNW- GTR-776. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific North- west Research Station. 51 p.

Peterson, D.W.,. Dodson, E.K., Harrod, R.J. 2014. Post-fire logging reduces surface woody fuels up to four decades following wildfire. Forest Ecology and Management 338 (2015) 84–91, 8 p.

Pfankuch, D.J. 1975. Stream reach inventory and channel stability evaluation. U.S. Department of Agriculture, Forest Service, R1-75-002. Government Printing Office #696-260/200, Washington, D.C.; 26 p.

Pilliod, D.S., Bury, R. B., Hyde, E.J., Pearl, C.A., Corn, P.J. 2003. Fire and amphibians in North America. Forest Ecology and Management 178 (2003) 163-181.

Poff, R.J. 1989. Compatibility of Timber Salvage Operations with Watershed Values. USDA Forest Service Gen. Tech. Rep. PSW-109.

Potter, D. 1994. Guide to forested communities of the upper montane in the central and southern Sierra Nevada. R5-ECOL-TP-003. Albany, CA. Pacific Southwest Region (R5), Forest Service, U.S. Department of Agriculture. 164p.

Pounds, J.A., Fogden, M.P.L., Campbell, J.H.. 1999. Biological response to climate change on a tropical mountain. Nature, Vol. 398. pp. 611-615.

Pounds. J.A. Crump, M.L. 1994. The case of the golden trout and the Harlequin frog.Conservation Biology, Vol. 8, No. 1, 72-85pp.

Powell, R.A., Zielinksi, W.J.. 1994. Fisher. in Scientific basis for conserving forest carnivores: marten, fisher, lynx and wolverine in the western United States (L.F. Ruggerio, K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski, eds), United States Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado, General Technical Report RM-254. 38-73pp.

Powell, R.A. 1993. The fisher: life history, ecology, and behavior. University of Minnesota Press, Minneapolis, Minnesota, USA

Powers, R.F., Sanchez, F. G., Scott, D. A., Page-Dumroese, D.. 2004. The North American long-term soil productivity experiment: coast-to-coast findings from the first decade. USDA Forest Service Proceedings RMRS-P-34. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 16 p.

Powers, R.F. 2002. Effects of soil disturbance on the fundamental, sustainable productivity of managed forests. USDA Forest Service Gen. Tech. Rep. PSW-GTR-183.

Pusina, T, March 2013. Personal communication. Division Chief Fuels Management Yosemite National Park. About approximate prescribed burning acreages within Yosemite National Park in the past 10 years.

Randall, J.M. 2000. Cirsium vulgare. In: Bossard, C.C.; Randall, J.M.; Hoshovsky, M.C. (Eds.) Invasive plants of California's wildlands. Berkeley, CA: University of California Press. www.cal-ipc.org (29 July 2015).

Raedeke, K.J. [Ed.]. 1988. Streamside management: Riparian wildlife and forestry interactions, Contribution No. 59. Institute of Forest Resources. University of Washington, Seattle. In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Reaser, J.K., Blaustein,A.. 2005. Repercussions of global change. In: Amphibian Declines, the Conservation Status of United States Amphibians. Edited by M. Lanoo. University of California Press.

Ratcliff, A.W. et al. Changes in microbial community structure following herbicide (glyphosate) additions to forest soils. Applied Soil Ecology 34 (2006) 114-124.

Rebain, S.A. 2010 (revised May 10, 2011). The Fire and Fuels Extension to the Forest Vegetation Simulator: Updated model documentation. internal rep. Fort Collins, CO: U. S. Department of Agriculture, Forest Service, Forest Management Service Center. 387p.

Reeves, G.H., Bisson, P.A., Rieman B.R., Benda, L.E. 2006. Post fire logging in riparian areas. Conservation Biology, 20(4): 994-1004.

Reid, L., Dunne, T. 1984. Sediment production from forest road surfaces. Water Resources Research Vol. 20, No. 11, pages 1753-1761.

Reinart, D., Fletcher D. 1977. 8-Day Dietary LC50 Study with Borax in Bobwhite Quail: IBT No. 8580- 10597. Unpublished study prepared by Industrial Bio-Test Laboratories, Inc. 14 p. MRID 00142633.

Reineke, L.H. 1933. Perfecting a stand density index for even-aged forests. Journal of Agricultural Research. 46:627-638.

Reinhardt, E.; Crookston, N.L. (Technical Editors). 2003. The Fire and Fuels Extension to the Forest Vegetation Simulator. Gen. Tech. Rep. RMRS-GTR-116. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 209 p.

Relyea, R.A. 2005. The Lethal Impacts of Roundup on Aquatic and Terrestrial Amphibians. Ecological Applications, 15(4), 2005, pp. 1118–1124.

Resh, S.C., Ryan, M.G., Joyce, L.,Binkley, D. 2006. Chipping and mastication in forest ecosystems-a synthesis (unpublished manuscript). In Dwire, K.A, Rhoades, C.C.,

Young, M.K. 2010. Potential Effects of Fuel Management Activities on Riparian Areas. Gen. Tech. Rep. RMRS-GTR-231, Department of Agriculture, Forest Service, Rocky Mountain Research Station. Chapter 10 pp 175-205. 2010.

Reynolds, R.T.; Graham, R.T.; Reiser, M.H.; Bassett, R.L.; Kennedy, P.L.; Boyce, D.A.., Jr; Goodwin, G., Smith, R., Fisher, E.L. 1992. Management recommendations for the northern goshawk in the southwestern United States. General Technical Report RM-217. USDA Forest Service.

Rhodes, J.J., Baker, W.L.. 2008. Fire probability, fuel treatment effectiveness and ecological tradeoffs in Western U.S. public forests. The Open Forest Science Journal, 2008, 1,1-7.

Rieman, B., Dunham, J., Luce, C., Rosenberger, A. 2005. Implications of changing fire regimes for aquatic ecosystems, In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep.RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Ritchie, M.W.; Knapp, E.E.; Skinner, C.N. 2013. Snag longevity and surface fuel accumulation following post-fire logging in a ponderosa pine dominated forest. Forest Ecology and Management 287 (2013). 113 – 122.

Robichaud, P.R.; Elliot, W.J., Pierson, F.B.. Hall, D.E., Moffet, C.A. 2006. Erosion Risk Management Tool (ERMiT) Ver. 2013.03.01. [Online at http://forest.moscowfsl.wsu.edu/fswepp/]. Moscow, ID: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Robichaud, P.R., Beyers, J.L. Neary, D.G. 2000. Evaluating the effectiveness of postfire rehabilitation treatments. RMRS-GTR-63. USDA Forest Service Rocky Mountain Research Station, Fort Collins, CO. 85p.

Roche, L.M.., Latimer, A.M., Eastburn, D.J., Tate, K.W. 2012b. Cattle Grazing and Conservation of a Meadow-Dependent Amphibian Species in the Sierra Nevada. LoS ONE 7(4): 0035734. doi:10.1371/journal.pone.

Roche, L.M., Allen-Diaz, B., Eastburn, D. J., Tate, K.W. 2012a. Cattle Grazing in Yosemite Toad (Bufo canorus Camp) Breeding Habitat in Sierra Nevada Meadows. Rangeland Ecology & Management. Vo. 65(1). January 2012. 56-65pp.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

Rothermel, R.C. 1983. How to predict the Spread and Intensity of Forest and Range Fires. USDA Forest Service, National Wildfire Coordinating Group, US DA Forest Service and US Department of the Interior. PMS-436-1.

Russell, R.E., Saab, V.A. Dudley, J.G., Rotella, J.J. 2006. Forest Ecology and Management, 232: 179- 187.

Russell, R.E., Saab, V.A., Dudley, J.G., Rotella, J.J. 2006. Snag longevity in relation to wildfire and postfire salvage logging. Forest Ecology.

Russell, K.R., Van Lear,D.H., Guynn, D.C. 1999. Prescribed fire effects on herpetofauna: review and management implications. Wildlife Society Bulletin 27:374–384.

Ryan, R.L. 2005. Social Science to Improve Fuels Management: A Synthesis of Research on Aesthetics and Fuels Management. Gen. Tech. Rep. NC-261. St. Paul, MN: USDA, Forest Service, North Central Research Station, 2005.

Safford, H.D. 2013. Natural Range of Variation (NRV) for yellow pine and mixed conifer forests in the bioregional assessment area, including the Sierra Nevada, southern Cascades, and Modoc and Inyo National Forests. Unpublished report. USDA Forest Service, Pacific Southwest Region, Vallejo, CA.

Safford H.D., Stephens, J.T., Meyer, M.D., Latimer, A.M. 2012a. Fuels treatment effectiveness in California yellow pine and mixed conifer forests. Forest Ecology and Management 274 (2012) 17-28.

Safford H.D., Schmidt, D.A., Carlson, C.H. 2009. Effects of Fuel treatments on fire severity in an area of wildland-urban interface, Angora Fire, Lake Tahoe Basin, California. Forest Ecology and Management 258 (2009) 773-787.

San Joaquin Valley Air Pollution Control District. https://www.valleyair.org. (29 July 2015).

Sartwell, C., Stevens, R.E. 1975. Mountain Pine Beetle in Ponderosa Pine prospects for silvicultural control in second-growth stands. Journal of Forestry, 136-140.

Savage, M. 1994. Anthropogenic and natural disturbance and patterns of mortality in a mixed conifer forest in California. Canadian Journal of Forest Research. 24: 1149-1159.

Scheller, R.M., Spencer, W., Rustigian-Romsos,H., Syphard, A., Ward,B.c., Strittholt, J. 2011. Using stochastic simulation to evaluate competing risks of wildfires and fuels management on an isolated forest carnivore. Landscape Ecology 26(10):1491-1504.

Schnackenberg, E.S., MacDonald, L.H. 1998. Detecting cumulative effects on headwater streams in the Routt National Forest, Colorado. JAWRA 34(5):1163-1177.

Seamans, M.E.; Gutiérrez, R.J. 2007a. Sources of variability in spotted owl population growth rate: testing predictions using long-term mark-recapture data. Oecologia. 152(1): 57–70.

Seamans, M.E., Gutiérrez, R.J. 2007b. Habitat selection in a changing environment: The relationship between habitat alteration and spotted owl territory occupancy and breeding dispersal. Condor. 109: 566–576.

Seglund, A.E. 1995. The use of resting sites by the Pacific fisher. Thesis, Humboldt State University, Arcata, California, USA.

Semlitsch, R.D., Bodie, J.R. 2003. Biological criteria for buffer zones around wetlands and riparian habitats for amphibians and reptiles. Conservation Biology. 17: 1219-1228. In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Semlitsch, R.D., 2000. Principles for management of aquatic-breeding amphibians. J. Wildlife Manage. 64, 615–631. In Olson, D.H., Anderson, P.D., Frissell, C.A., Welsh, H.H., Bradford, D.F. Biodiversity management approaches for stream-riparian areas: Perspective for Pacific Northwest headwater forests, microclimates, and amphibians. Forest Ecology and Management 426 (2007) 81-107.

Semlitsch, R.D. 1998. Biological delineation of terrestrial buffer zones for pond-breeding salamanders. Conservation Biology. 12: 1113-1119. In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Sensenig, T., Bailey, J.D., Tappeiner, J.C. 2013. Stand development, fire and growth of old-growth and young forests in southwestern Oregon, USA. Forest Ecology and Management, 291, 96.

Syracuse Environmental Research Associates, Inc. 2011.Glyphosate- Human health and ecological Risk assessment- final report. SERA TR-052-22-03b. Report dated March 25, 2011.

Syracuse Environmental Research Associates, Inc. 2011. Utility for adding pesticides and formulations to worksheet maker. Version 6 [Utility Version 1.02]. SERA TR-052-28-01i. Report dated December 17, 2011.

Syracuse Environmental Research Associates, Inc. 2006. Borax (Sporax®)- Human health and ecological risk assessment- final report. SERA TR-04-43-21. Report dated February 24, 2006.

Syracuse Environmental Research Associates, Inc. 2003. Glyphosate – Human health and ecological risk assessment final report. Syracuse Environmental Research Associates, Inc. Fayetteville, NY. SERA TR 02-43-09-04a.

Syracuse Environmental Research Associates, Inc.1997a. Effects of Surfactants on the Toxicity of Glyphosate, with Specific Reference to RODEO. SERA TR 97-206-1b. Report dated February 6, 1997.

Syracuse Environmental Research Associates, Inc. 1997b. Use and assessment of marker dyes used with herbicides. SERA TR 96-21-07-03b. Report dated December 21, 1997.

Shakesby, R.A., Doerr, S.H.. 2006. Wildfire as a hydrological and geomorphological agent. Earth-Science Reviews, 74(2006):269-307.

Shatford, J.P.A., Hibbs, D.E., Puettmann, K.J. 2007. Conifer regeneration after forest fire in the Klamath-Siskiyous: how much, how soon?. Journal of Forestry, 105(3), 139-146.

Shehade SA; Beck MH; Chalmers R JG. 1987. Allergic contact dermatitis to Crystal Violet in carbonless copy paper. Cont. Dermat. 17(5): 310-311Simmons, N.B. 2005. Chiroptera. Pp. 312-529, in Mammal Species of the World: a taxonomic and geographic reference. D.E. Wilson and D.M. Reeder, Editors. Volume I. Johns Hopkins University Press, Baltimore, 743 pp

Skinner, C., Weatherspoon, P. 1996.. Landscape level strategies for forest fuels management. Pacific Southwest Research Station. Redding, CA. 22p.

Smith, D. 2015. Silviculture Report for the French Recovery and Reforestation Project. USDA FS.

Smith, J.K. [Ed.]. 2000. Wildland fire in ecosystems: Effects of fire on fauna. RMRS-GTR-42. Vol. 1. Fort Collins, CO. USDA Forest Service. Rocky Mountain Research Station. 83 p. In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Smith, S.L. Cluck, D.R. 2011. Marking guidelines for fire-injured trees in California, May 2011, Report #RO-11-01, US Forest Service, Region 5. Forest Health Protection.

Solomon, K., Thompson, D.. 2003. Ecological Risk Assessment for Aquatic Organisms from Over-Water Uses of Glyphosate. Journal of Toxicology and Environmental Health, Part B: Critical Reviews. Volume 6, Issue 3, 289-324pp.

Southern Sierra Smoke Management Group and San Joaquin Valley Air Pollution Staff. Unified Guidelines and Procedures for Smoke Management, March 2009.

Spanos,et al. 2005. Effects of postfire logging on soil and vegetation recovery in a Pinus halepensis Mill. Forest of Greece. Plant and Soil, vol 278. 171-179pp.

Spencer, W.D., Sawyer, S.C., Romsos, H.L., Zielinski, W.J., Sweitzer, R.A., Thompson, C.M., Purcell, K.L., Clifford, D.L., Cline, L., Safford, H.D., Britting, S.A., Tucker, J.M.. 2015. Southern Sierra Nevada fisher conservation assessment. Unpublished report produced by Conservation Biology Institute.

Spencer, W.D., Rustigian, H.L., Scheller, R.M., Syphard, A., Strittholt, J., Ward, B. 2008. Baseline evaluation of fisher habitat and popualtion status, and effects of fires and fuels management on fishers in the southern Sierra Nevada. Pacific Southwest Region. June 2008. Appendices and 133 pp.

Spencer, W., Rustigian, H., Scheller, R., ASyphard, A., Strittholt, J., Ward, B. 2007. Baseline evaluation of fisher habitat and population status & effects of fires and fuels management on fishers in the Southern Sierra Nevada. Conservation Biology Institute prepared for USDA Forest Service. June.2007.

Spies, T.A., Miller, J.D., Buchanan, J.B., Lehmkuhl, J.F., Franklin, J.F., Healey, S.P., Hessburg, P.F., Safford, H.D., Cohen, W.B., Kennedy, R.S.H., Knapp, E.E., Agee, J.K., Moeur, M. 2009. Underestimating risk to the Northern spotted owl in fire-prone forests: a response to Hanson, et al. Conservation Biology. 24(1) 330-333.

Stalter, B. 2015. French Fire Recovery and Restoration Project – Fire and fuels specialist report. Sierra National Forest. Open file report. On file at the Bass Lake Ranger District, North Fork, CA.

Stalter, Burt 2014. Personal observations to French Fire. August 2014. On the ground corporate knowledge gained while employed on the Minarets and Bass Lake Ranger Districts Sierra National Forest from 6-1988 to present.

Stark, J.D., Walthall, W. 2003. Agricultural Adjuvants: Acute mortality and effects on population growth rate on daphnia pulex after chronic exposure. Environmental toxicology and chemistry 22(12):3056-3061. In BLM 2007. BLM Vegetation treatments using herbicides – Appendix D: Evaluation of risks from degradates, polyoxyethylene-amine (POEA) and R-11, and endrocrine distrupting chemicals. final programmatic EIS. June 2007. 40 p

Stebbins, R.C., Cohen, N.W.. 1995. A natural history of amphibians. Princeton University Press, Princeton, New Jersey. 304 p. http://books.google.com/books?id=0v47ou53yVsC&lpg=PR11&ots=omj83sW3Nx&dq=A%20natural%20history%20of%20amphibians&lr&pg=PA112#v=onepage&q&f=false (29 July 2015).

Stephens S.L.; McIver J.D., Boehrner, R.E.J., Fettid, C.J.; Fontaine, J.B., Hartsough, B.R., Kennedy, P.L., Schwilk, D.W. 2012. The effects of forest fuel-reduction treatments in the United States. BioScience 62:549-560.

Stephens S.L., Moghaddas, J.L., Hartsough, B.R., Moghaddas, E.Y. and Nicholas C.E. 2009. Fuel treatment effects on stand-level carbon pools, treatment-related emissions, and fire risk in a Sierra Nevada mixed-conifer forest. Canadian Journal of Forest Research. 39:1538-1547.

Stephens, S.L., 2005. Forest fire causes and extend on United States Forest Service lands. International Journal of Wildland fire, 2005, 14, 213-222.

Stephens, S.L., Finney, M.A 2001. Prescribed fire mortality of Sierra Nevada mixed conifer tree species: effects of crown damage and forest floor combustion. Forest Ecology and Management, Volume 5575: 1-11.

Stevens-Rumann, C.; Shive, K.; Fule P., Sieg, C.H.. 2013. Pre-wildfire fuel reduction treatments result in more resilient forest structure a decade after wildfire. International Journal of Wildland Fire. 2013, 22, 1108-1117.

Stewart, M.M. 1995. Climate Driven Population Fluctuations in Rain Forest Frogs. Journal of Herpetology, Vol. 29, No. 3 (Sep., 1995), 437-446pp.

Stone, K.A. 2015. French Fire Recovery and Restoration Project – Hydrologist Specialist Report. Sierra National Forest. Open file report. On file at the Bass Lake Ranger District, North Fork, CA.

Strand, P. 2008. California red-legged frog site assessment for 4 Grazing Allotments on the Bass Lake Ranger District of the Sierra National Forest. US Forest Service, Sierra National Forest, Clovis, CA. 94p.

Swanson, M.E., Franklin ,J.F., Beschta, R.L., Crisafulli, C.M., DellaSala ,D.A., Hutto, R.L., Lindenmayer, D.B., Swanson, F.J.. 2010. The forgotten stage of forest succession: early-successional ecosystems on forest sites

Takenaka, K. 2014. French Fire BAER Soil Report. Open file report. Sierra National Forest. 1600 Tollhouse Road, Clovis, CA 93611Tappeiner, J. C., and S. R. Radosevich. 1982. Effect of Bearmat (chamaebatia foliolosa) on soil moisture and ponderosa pine growth. Weed Science. 30: 98-101.

Tate, K.W., Allen-Diaz, B. 2010. 2009 Accomplishment and results report. Determining the effects of livestock grazing on Yosemite Toad (*Bufo canorus*) and their habitat: An adaptive management study.

Tempel, D.J.; Peery, M.Z.; Gutierrez, R.J. 2014. Using integrated population models to improve conservation monitoring: California spotted owls as a case study. Ecological Modelling 289:86-95.

Thomas, S.M; MacPhee, D.G. 1984. Crystal violet: A direct acting frameshift mutagen whose mutagenicity is enhanced by mammalian metabolism. Mutat. Res. 140(4): 165-168.

Thompson, C.M.,. Purcell, K.L., Garner, J., Green, R. 2010. Kings River fisher project: progress report 2007-2010. USDA Forest Service, Pacific Southwest Research Station, Fresno, CA.

Thompson, J. 2005. Keeping it cool: unraveling the influences on stream temperature. PNW Research Station Science Findings, Issue 73.

Thompson, I.D., Baker, J.A., Ter-Mikaelian, M.. 2003. A review of the long-term effects of post harvest silviculture on vertebrate wildlife, and predictive models, with an emphasis on boreal forests in Ontario, Canada. Forest Ecology and Management. 177: 441-469. In Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Timossi, I. 1990. California's statewide wildlife habitat relationships system. Calif. Dept. of fish and Game. Sacramento, CA. Computerized database.

Troendle, C.A., MacDonald, L.H., Luce, C.H. 2010. Fuels management and water yield. Chapter 7 in: Elliot, W.J., I.S. Miller, and L. Audin, eds., Cumulative watershed effects of fuel management in the western United States. RMRS-GTR-231, Fort Collins, CO. 299p.

Troendle, C.A., MacDonald, L.H., Luce, C.H. 2006 (May 22, last update). Fuels management and water yield. Chapter 7 in: Elliot, W.J., and L.J. Audin, eds. Draft cumulative watershed effects of fuels management in the western United States. http://forest.moscowfsl.wsu.edu/engr/cwe/ (29 July 2015).

Troendle, C.A., Wilcox, M.S., Bevenger, G.S., Porth, L.S. 2001. The Coon Creek water yield augmentation project: implementation to timber harvesting technology to increase streamflow. Forest Ecology and Management 143 (2001) 179-187pp.

Trombulak, S.C., Frissell, C.A.. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation biology, Vol. 14, No. 1, 18-30pp.

Tucker, J.M., Schwartz, M.K., Truex, R.L., Wisely, S.M., Allendorf, F.W. 2014. Sampling affects the detection of genetic subdivision and conservation implications for fisher in the Sierra Nevada. Conservation Genetics 15:123-136. doi:10-1007/s10592-013-0525-4.

Tucker, J.M., Schwartz, M.K., Pilgrim, K.L., Allendorf, F.W. 2012. Historical and contemporary DNA indicate fisher decline and isolation occurred prior to the European settlement of California. PLOS ONE 7(12):e52803. doi:10.1371/journal.pone.0052803.

Tucker, J.M., Truex, R., Bolis, J., Schwartz, M., Allendorf, F.W. 2009. Using landscape genetics to assess the genetic structure and population connectivity of fishers in the Sierra Nevada. Student paper presented at the 2009 Annual Conference of the Western Section of the Wildlife Society, Sacramento, CA. January 21-24, 2009.

Truex, R.L., Zielinski, W.J., Golightly, R.T., Barrett, R.L., Wisely, S.M. 1998. A meta-analysis of regional variation in fisher morphology, demography, and habitat ecology in California (draft report submitted to California Department of Fish and Game). USDA Forest Service, Pacific Southwest Research Station, Redwood Sciences Lab, Fort Collins, Colorado.

Trumbo, J. 2005. An assessment of the Hazard of a mixture of the herbicide Rodeo and the non-ionic surfactant R-11 to aquatic invertebrates and larval amphibians. California Fish and Game 91(1):38-46 2005. Page 110 of 128 Aquatic Species Biological Assessment and Evaluation for the Soaproot Project 2012 Sierra National Forest, High Sierra Ranger District.

UC Berkeley. 2015. Data from Consortium of California Herbaria (ucjeps.berkeley.edu/consortium/).

United States Forest Service. 2015a. Interpretation of Limited Operating Period (LOP) standards for California spotted owl in Sierra Nevada National Forests. April 6, 2015.

United States Forest Service, 2015. Pesticide human health risk assessment for the French Fire Recovery and Reforestation Project, Sierra National Forest. Prepared by Joanna Clines, Forest Botanist, worksheets run by Dave Bakke. In Project Record and available at Bass Lake Ranger District, North Fork, CA.

United States Forest Service. 2014. Pacific Southwest Region. Pacific Southwest Region sensitive species list. October 10, 2014

United States Forest Service 2014. Forest Service Manual 2400, Forest Management, Chapter 2470, Silvicultural Practices; 2472.33 - Reforestation Protection. March 6, 2014

United States Forest Service 2013. Programmatic Agreement Among the U.S.D.A. Forest Service, Pacific Southwest Region, California State Historic Preservation Officer, Nevada State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Processes for Compliance with Section 106 of the National Historic Preservation Act for Management of Historic Properties by the National Forests of the Pacific Southwest Region.

United States Forest Service. 2012. National Best Management Practices for water quality management on National Forest System Lands. Volume 1: National Core BMP

Technical Guide. USDA FS, FS-990a. April 2012. 165p. http://www.fs.fed.us/biology/resources/pubs/watershed/FS_National_Core_BMPs_April2012.pdf. (29 July 2015).

United States Forest Service, Inyo National Forest, 2012. Forest Service Recreation and Natural Resources Briefing Paper, Clearing after the Devils Windstorm-Cutting Blown down Trees from Trails, Inyo National Forest, California. 10-2012, 20 p.

United States Forest Service. 2012. FSM 2500 R5 Supplement - Watershed And Air Management, Chapter 2550 - Soil Management, Clovis, California, Sierra National Forest Supervisors Office, U.S. Department of Agriculture, Forest Service.

United States Forest Service. 2011. R5 Forest Service Handbook 2509.22 – Soil and Water Conservation Handbook, Chapter 10 – Water Quality Management Handbook. Amendment No. 2509.22-2011-1. 12/15/2011. 262p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5399662.pdf (29 July 2015).

United States Forest Service. 2011. Forest Service Handbook 2509.22, Soil and Water Conservation Practices Handbook, Chapter 10. R5 Supplement 2509.22-2011-1. 237 p.

United States Forest Service. 2010. Final Environmental Impact Statement. Sierra National Forest Motorized Travel Management. R5-MB-211b March 2010.

United States Forest Service. 2010b. Pacific Southwest Region Forest Service Handbook 3409.11, R5 Supplement No. 3409.11-10-1.

United States Forest Service. 2008. Technology and Development Program. Using subsoiling to reduce soil compaction. Gary Kees. (July). Missoula, Montana.

United States Forest Service. 2007. Recreation Facility Analysis. 5-year Program of Work and Programmatic Results of Implementation. Sierra National Forest, 2007.

United States Forest Service. 2006. Human health and ecological risk assessment for borax (Sporax). Forest Health Protection, USDA Forest Service, Arlington, VA. 136p.

United States Forest Service. 2004a. Final Supplemental Environmental Impact Statement Sierra Nevada Forest Plan Amendment. USDA Forest Service Pacific Southwest Region, Vallejo, CA.

United States Forest Service. 2004b. Record of Decision Sierra Nevada Forest Plan Amendment. USDA Forest Service Pacific Southwest Region, Vallejo, CA.

United States Forest Service 2004c. Forest Service Manual (FSM) 2472.33 Reforestation Protection.

United States Forest Service 2004d. Sierra Nevada Forest Plan Amendment Record of Decision and Final Supplemental Environmental Impact Statement. USDA Forest Service, Pacific Southwest Region. Vallejo, CA (ROD). January . 492pp and 72 pp.

United States Forest Service. 2004e. Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement, Record of Decision (ROD). R5-MB-046. Pacific Southwest Region, Vallejo, CA. 72p.

http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5416715.pdf (29 July 2015).

United States Forest Service, Pacific Southwest Region, 2003. Human and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications. Prepared by David Bakke, Pesticide Use Specialist. USDA Forest Service. 2000. Assessment of BE's and BA's – Region 5 by John C. Robinson. USDA Forest Service, Pacific Southwest Region. Vallejo, CA..8p. http://fsweb.r5.fs.fed.us/unit/ec/be_ba/BEBA_assessment.html (29 July 2015).

United States Forest Service. 2001. Pacific Southwest Region. Sierra Nevada Forest Plan Amendment, Final Environmental Impact Statement. Vallejo, CA

United States Forest Service. 2001b. Sierra Nevada Forest Plan Amendment. Final Environmental Impact Statement. Volume 3 of 6 (Chapter 3, Part 4). January. Part 4.5 43-44pp. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5346866.pdf. (29 July 2015).

United States Forest Service. 2000. Water quality management for National Forest system lands in California (Best Management Practices). FSH 2509.22 Soil and Water Conservation Handbook.

United States Forest Service. 1997. Glyphosate herbicide information profile. Pacific Northwest Region. February 1997. 16p.

United States Forest Service 1992; Forest Land and Resource Management Plan-Sierra National Forest. Pacific Southwest Region, Sierra National Forest. Clovis, CA September 24.

United States Forest Service. 1992a. Sierra National Forest Land and Resource Management Plan. USDA, Forest Service, Pacific Southwest Region, Sierra National Forest. September 24.

United States Forest Service 1992b. Forest Service Handbook. FSH 7709.58, Transportation System Maintenance Handbook: Maintenance Level Descriptions, Maintenance Activities and Maintenance Standards, and Maintenance Sharing, WO Amendment 7709.58-92-1, 9/4/92.

United States Forest Service. 1992c. Pacific Southwest Region Forest Service Manual 2303.14, R5 Supplement 2300-92-1.

United States Forest Service . 1991 Forest Service, R-5 Forest Service Handbook. Silviculture, 2409.26b.

United States Forest Service 1991. Riparian Forest Buffers. Function and Design for Protection and Enhancement of Water Resources. NA-PR-07-91., Radnor, PA. U.S. Department of Agriculture, Forest Service, Northeastern Area State & Private Forestry. 31 pp.

United States Forest Service. 1991. Sierra National Forest Land and Resource Management Plan. Sierra National Forest, Clovis, CA..

United States Forest Service 1991. Sierra National Forest Land and Resource Management Plan. USDA, Forest Service, Pacific Southwest Region, Sierra National Forest.

United States Forest Service 1990. R5 Forest Service Handbook 2509.22 - Soil and Water Conservation Handbook, Chapter 20 – Cumulative Off-site Watershed Effects Analysis. Amendment 2, effective 7/16/1990.

United States Forest Service. 1989. Forest Service Handbook 2509.22, Soil and Water Conservation Practices Handbook, Sierra National Forest Supplement No. 1. 13 pp USDA Forest Service. 1989. Forest Service Handbook 2509.22, Soil and Water Conservation Practices Handbook, Sierra National Forest Supplement No. 1. 13 pp USDA Forest Service. 1989. Forest Service Handbook 2509.22, Soil and Water Conservation Practices Handbook, Sierra National Forest Supplement No. 1. 13 pp.

United States Forest Service. 1989. FSH 2509.22 Soil and Water Conservation Practices Handbook, Sierra National Forest Supplement No. 1. August 1989. 12p.

United States Department of Interior 2015, Fish and Wildlife Service. Federal Endangered and Threatened Species that may be affected by Projects in the Sierra National Forest. Database last updated March 6, 2015, Report date: March 6, 2015. http://www.fws.gov/sacramento/ES_Species/Lists/es_species_lists_NF-action-page.cfm (29 July 2015).

United States Department of Interior. 2014. Fish and Wildlife Service Endangered and Threatened Wildlife and Plants; Threatened Species Status for West Coast Distinct Population Segment of Fisher; Proposed Rule. Federal Register 79:60419-60443.

United States Department of Interior. 2013a. Fish and Wildlife Service. Endangered and Threatened Wildlife and Plants; Endangered Status for the Sierra Nevada Yellow-Legged Frog and the Northern Distinct Population Segment of the Mountain Yellow-Legged Frog, and Threatened Status for the Yosemite Toad; Proposed Rule YT and MYLF, SNYLF listing. Federal Register, Vol. 78, No. 80, April 25, 2013. 24471-24514.

United States Department of Interior 2013b. Fish and Wildlife Service Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Sierra Nevada Yellow-Legged Frog, the Northern Distinct Population Segment of the Mountain Yellow-Legged Frog, and the Yosemite Toad; Proposed Rule. Federal Register, Vol. 71, No. 80. April 25, 2013. 24515-24574.

United States Department of Interior. 2006. Fish and Wildlife Service 12-month Finding for a Petition to List the California Spotted Owl (Strix occidentalis occidentalis) as Threatened or Endangered. Federal Register 71 (100): 29886-29908.

United States Environmental Protection Agency. 2009. Glyphosate Registration Review. Docket ID EPA-HQ-OPP-2009-0361. http://www.regulations.gov/#!docketDetail;D=EPA-HQ-OPP-2009-0361. (5 May 5, 2015).

United States Environmental Protection Agency. 2011. Ecological Risk Assessment Step 2. EPA. Environmental Protection Agency, published 28 Dec. 2011. http.//www.regulations.gov (21 Mar. 2014).

United States Environmental Protection Agency. 2004a. United States Environmental Protection Agency Integrated Risk Information System. Boron (Boron and Borates only) (CASRN 7440-42-8). Last reviewed 08/05/2004. http://www.epa.gov.iris.subst.0410.htm. (29 July 2105).

United States Environmental Protection Agency. 2004b. Office of Prevention, Pesticides, and Toxic Substances. Overview of the ecological risk assessment process in the office of pesticide programs, endangered and threatened species effects determinations.

United States Environmental Protection Agency 1993. Office of Prevention, Pesticides and Toxic Substances. EFED (Environmental Fate and Effects Division) Science Chapter for Boric Acid/Sodium Metaborate RED (Chemicals #011001, 011103; Case #0034). June 1, 1993.US.

United States Environmental Protection Agency. 2015. http://www.epa.gov. (29 July 2015).

van Wagtendonk, J.W., van Wagtendonk, K.A., Thode, A.E. 2012. Factors associated with the severity of intersecting fires in Yosemite National Park, California, USA. Fire Ecology: 8(1): 11- 31. doi: 10.4996/fireecology.0801011.

van Wagtendonk, J.W., Fites-Kaufman, J. 2006. Sierra Nevada Bioregion. In Fire in California's Ecosystems. Berkley: University of California Press. Ch. 12, pp. 264-293Vander Wall, S. B. 1992. The role of animals in dispersing a" wind-dispersed" pine. The Ecological Society of America. 614-621pp.

Van Mantgem, P.J., Nesmith, J.C., Keifer, M.,. Knapp, E., Flint, A., Flint, L. 2013. Climatic stress increases forest fire severity across the western United States. Ecology Letters. 6 p.

van Mantgem, P. J., Stephenson, N. L. 2007. Apparent climatically-induced increase of tree mortality rates in a temperate forest. Ecology Letters 10:909-916.

Verner, J. K., McKelvey, S., Noon,B.R., Guiterrez, R.J., Gould,G.I. Jr., Beck, T.W. 1992. The California spotted owl: a technical assessment of its current status. General Technical Report PSW-GTR-133. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. 285p.

Wagenbrenner, J.W., MacDonald, L.H., Coats, R.N., Robichaud, P.R., Brown, R.E. 2014. Effects of post-fire salvage logging and a skid trail treatment on ground cover, soils, and sediment production in the interior Western United States. forest ecology and management 335: 176-193.

Wagener, W.W., Offord, H.R. 1972. Logging slash: Its breakdown and decay at two forests in northern California.

Wallbrink, P.J., Croke, J. 2002. A combined rainfall simulator and tracer approach to assess the role of Best Management Practices in minimizing sediment redistribution and loss in forests after harvesting. Forest Ecology and Management 170:217-232.

Wayman, R., North, M. 2007 Initial response of a mixed-conifer understory plant community to burning and thinning restoration treatments. Forest Ecology and Management. 239: 32-44.

Weller, T.J., Zabel, C.J. 2001. Characteristics of fringed myotis day roosts in northern California. Journal of Wildlife Management 65 (3):489-497.

Wemple, B.C., Jones, J.A., Gordon G. 1996. Channel network extension by logging roads in two basins, western Cascades, Oregon. Water Resources Bulletin, 32(6):1195-1207.

World Health Organization. 1998. Boron. Environmental health criteria 204. http://www.inchem.org/documents/ehc/ehc/ehc204.htm (29 July 2015).

Wildland Fire Lessons Learned Center. 2000. Incident reviews of snag and felling reports http://www.wildfirelessons.net/home (29 July 2015).

Wilkens, A. 2015. Aquatic Species Biological Assessment & Biological Evaluation for the French Fire Recovery and Reforestation Project, Bass Lake Ranger District, Sierra National Forest. Available on file at the US Forest Service Bass Lake Ranger Station, North Fork, CA.

Wilken, G.C. 1967. History and fire record of a timberland brush field in the Sierra Nevada of California. Ecology 48:302-304.

Williams, M.A., Baker, W.L. 2012. Spatially extensive reconstructions show variable-severity fire and heterogeneous structure in historical western United States dry forests. Global Ecology and Biogeography, 21(10), 1042-1052.

Williams, A.L., Neville, H.M., Colyer, W.T. 2009. Potential Consequences of Climate Change to Persistence of Cutthroat Trout Populations. North American Journal of Fisheries Management. Vol. 29, Iss. 3, 2009.

Wilson M. 2015. Personal conversation. Fuels Captain, Sierra National Forest, Discussion about the fireline production rates and crew safety during his previous experience as a sawyer on the Crane Valley Hotshots and the fireline production rates when constructing firelines and working in old previously burned areas on wildfires throughout the western forests.

Wondzell, S.M., King, J.G. 2003. Post-fire erosional processes in the Pacific Northwest and Rocky Mountain regions. Forest Ecology and Management 178(2003):75-87.

Zabel, C.J., Steger, G.N., McKelvey, K.S., Eberlein, G.P., Noon, B.R., Verner, J. 1992. Home-range size and habitat-use patterns of California spotted owls in the Sierra Nevada. U.S. For. Serv. Gen. Tech.Rep. No. PSW-GTR-133. pp. 149-164.

Zhang, J. 2008. Reforestation of the Fountain Fire in Northern California: an untold story. Journal of Forestry. December 2008.

Zhang, J., Oliver,W.W., Busse, M.D. 2006. Growth and development of ponderosa pine on sites of contrasting productivities: relative importance of stand density and shrub competition effect. Canadian Journal for Forest Research. 36(10): 2426-2243.

Zielinski, W.J., Baldwin, J.A., Truex, R.L., Tucker.J.M., Flebbe, P.A 2013. Estimating Trend in Occupancy for the Southern Sierra Fisher Martes pennanti Population. Journal of Fish and Wildlife Management 4(1):3-19; e1944-687X. doi: 10.3996/012012-JFWM-002.

Zielinski, W.J., Duncan, N.P., Farmer, R.E.C., Truex, R.L., Clevenger,A.P., Barrett, R.H. 1999. Diet of fishers (*Martes pennanti*) at the southernmost extent of their range. Journal of Mammalogy 80 (3): 961-969.

Zwolinski, M. 2000. The role of fire in management of watershed responses. In: USDA Forest Service Proceedings RMRS-P-13.