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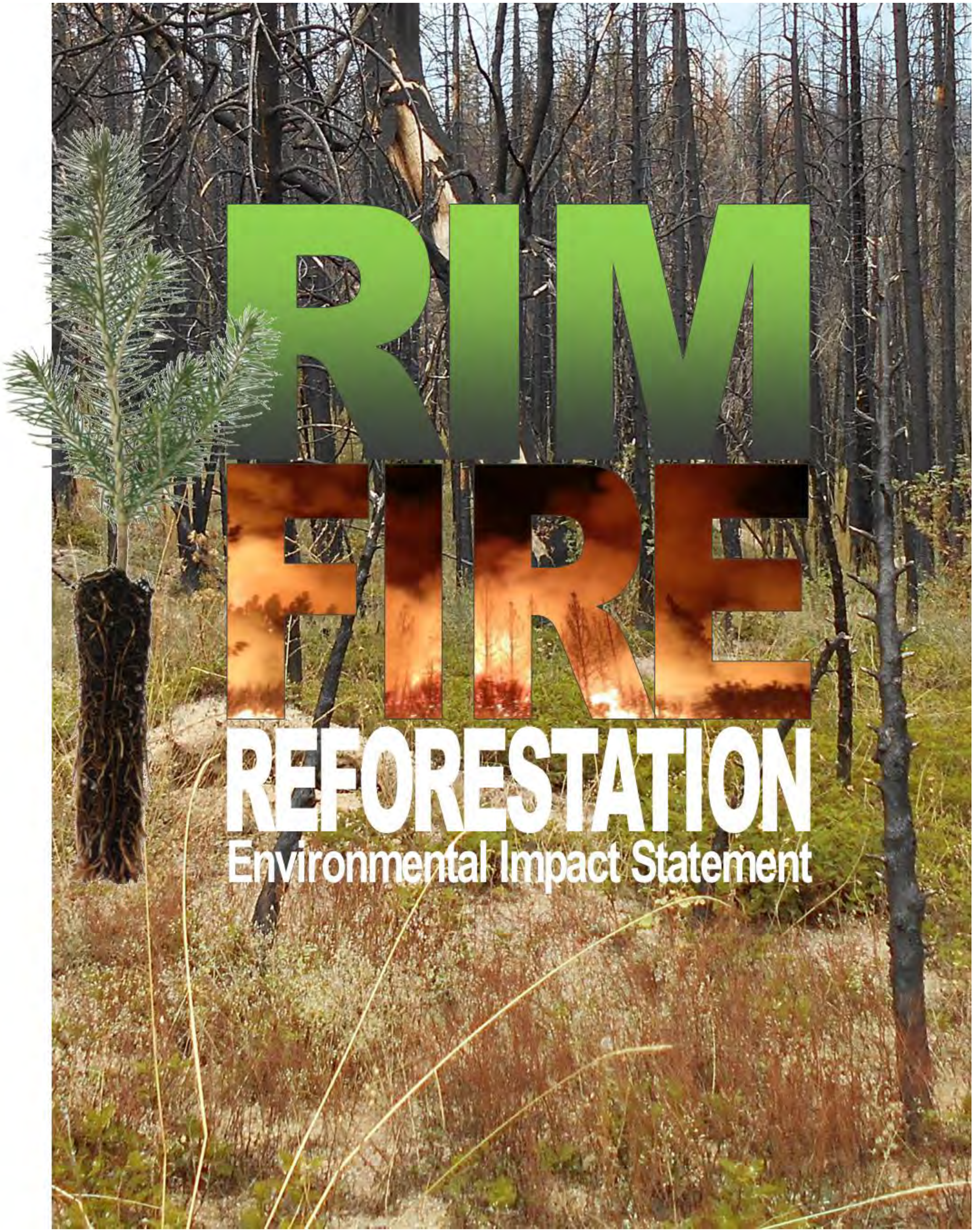

RIM FIRE REFORESTATION

Environmental Impact Statement

Forest Service | Stanislaus National Forest | R5-MB-279 | April 2016

Rim Fire Reforestation (45612)
Environmental Impact Statement
Stanislaus National Forest

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Cooperating Agencies: None

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Abstract: This Environmental Impact Statement (EIS) describes a proposal for about 48,000 acres of treatments on National Forest System lands within the 2013 Rim Fire including: deer habitat enhancement; natural regeneration; noxious weed eradication; reforestation; and, thin existing plantations. The EIS discloses the direct, indirect and cumulative environmental effects that would result from the proposed action, a no action alternative and three additional action alternatives. The Responsible Official has not identified a preferred alternative at this stage.

Cover Photo: The EIS proposes reforestation for this 2013 Rim Fire high severity burn area located off Road 1S04 near Sawmill Mountain. The photo shows bearclover, grasses and forbs returning in the foreground and standing dead trees in the background. (Forest Service, October 28, 2015)

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Summary

The Forest Service prepared this Environmental Impact Statement (EIS) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This EIS discloses the environmental impacts that would result from the proposed action, a no action alternative and 3 additional action alternatives developed in response to issues raised by the public. The Responsible Official has not identified a preferred alternative at this stage.

Background

The Rim Fire started on August 17, 2013 in a remote area of the Stanislaus National Forest near the confluence of the Clavey and Tuolumne Rivers about 20 miles east of Sonora, CA. Over several weeks it burned 257,314 acres, or 400 square miles including 154,530 acres of National Forest System (NFS) lands. The fire also burned within Yosemite National Park (78,895 acres), Sierra Pacific Industries private timberland (16,035 acres), other private land (7,725 acres) and Bureau of Land Management (BLM) land (129 acres). The Rim Fire Reforestation (Rim Reforestation) project is located within the Rim Fire perimeter in the Stanislaus National Forest on portions of the Mi-Wok and Groveland Ranger Districts (T3N-T2S, R16E-R19E; MDBM). The project area includes all NFS lands within the fire. It does not include Wilderness or any private, state or other federal lands.

Purpose and Need

Based on Forest Plan Direction, the overall purpose of the Rim Reforestation project is to: ***create a fire resilient mixed conifer forest that contributes to an ecologically healthy and resilient landscape rich in biodiversity***. The following needs are based on the overall purpose and Desired Future Condition (DFC) for Old Forest Mosaic, Open Canopy Mosaic and Deer Emphasis. Chapter 1.03 provides additional details.

1. Return Mixed Conifer Forest to the Landscape

Promote the re-establishment and recovery of conifer forests with diverse structure and composition to quickly meet future resource needs for wildlife, recreation, watershed and timber while taking into account potential pressures of a changing climate. The overall goal is to re-establish a conifer forest in an effort to contribute to an ecologically healthy and resilient landscape rich in biodiversity. This landscape would have an increased capacity to adapt and survive natural disturbances, especially under changing and uncertain future environmental conditions, such as those driven by climate change and human use. This project looks at the short-term (up to 10 years) proposing activities that incrementally move toward these long-term (60 to 100 years) goals, returning healthy vigorous trees in a mosaic of forest conditions across the landscape. (Old Forest Mosaic, Open Canopy Mosaic and Deer Emphasis DFCs)

2. Restore Old Forest for Wildlife Habitat and Connectivity

Restore old forest composition and structure to provide critical habitat for sensitive wildlife species such as the California spotted owl, northern goshawk and fisher. This includes restoring habitat connectivity compromised in the Rim Fire that is essential for wildlife dispersal, migration, and use of suitable habitat across the landscape. (Old Forest Mosaic Desired Future Condition)

3. Reduce Fuels for Future Fire Resiliency

Reduce the fuel load that exists from standing dead trees and re-sprouting brush, including portions of the burned area within existing older plantations. Re-establish open canopy forest stands to safely reintroduce fire into the landscape through fuels and vegetation management. (Open Canopy Mosaic DFC)

4. *Enhance Deer Habitat*

Restore forested conditions within critical winter deer range, providing thermal and hiding cover and access to high quality forage essential for over-wintering deer. (Deer Emphasis DFC)

5. *Eradicate Noxious Weeds*

Prevent new infestations of noxious weeds and the spread of existing weeds as the result of project activities. Reduce the quantity and extent of noxious weeds, and manage their adverse impacts on ecosystem structure and function, contribution to fine fuels, competition to young seedlings and impacts to biodiversity and native plants. (Old Forest Mosaic, Open Canopy Mosaic and Deer Emphasis DFCs)

Proposed Action

The Forest Service proposed action described in more detail as Alternative 1 (Proposed Action) includes the following treatments: Deer Habitat Enhancement (3,833 acres); Natural Regeneration (4,031 acres); Noxious Weed Eradication (5,714 acres); Reforestation (21,300 acres); and, Thin Existing Plantations (12,769 acres). Chapter 1.04 and Chapter 2.02 provide additional details.

Significant Issues

Scoping identified significant issues which are used to formulate alternatives, prescribe mitigations measures, or analyze environmental effects. Table S.01-1 displays the significant issues with issue statements based on public comments. Chapter 1.08 provides additional details.

Table S.01-1 Significant Issues

Issue/Element	Cause and Effect
1. Herbicides:	**The proposed herbicide applications may adversely affect human and other natural resources.**
1.1 Human Health	a. Toxins may contaminate the water supply, food chain and land, impacting residents and visitors through reproductive and developmental harm.
1.2 Native Species Health and Diversity	a. Herbicides may irretrievably alter natural post-fire successional habitat causing loss of significant biodiversity. b. Application of glyphosate formulations and other less understood herbicides may have negative direct, indirect and cumulative effects on aquatic species and terrestrial wildlife including: mortality; impaired growth and development; modified behavior; and, physiological or morphological effects.
2. Reforestation Method:	**The proposed reforestation methods may adversely affect human and other natural resources.**
2.1 Local Economy	a. Reforestation at low rates may take too long to reclaim control of the brush and competing vegetation. b. Future budgets may not provide adequate funding to control competing vegetation or thin trees. c. Low density planting may not provide a sustainable, long-term supply of wood needed to maintain the forest products infrastructure in Tuolumne County.
2.2 Native Species Health and Diversity	a. High density planting may limit fire use and foster unhealthy landscapes lacking biodiversity with reduced resiliency to drought, insects and wildfire. b. Low density planting may reduce wildlife hiding cover subjecting wildlife to increased vehicle related mortality, predation and poaching.
2.3 Forest Establishment	a. Wide and variable spacing and gaps between planted trees may complicate the planting process, favor competing vegetation and delay establishment of a new forest.
2.4 Fire Hazard	a. High density planting may result in fire-prone trees preventing early and frequent use of prescribed and natural fire. b. Wide and variable spacing and gaps between planted trees may result in areas with undesirable vegetation and increased fuel loading.

Alternatives Considered in Detail

The action alternatives (Alternatives 1, 3, 4 and 5) and the no action alternative (Alternative 2) are considered in detail. Chapter 2.02 provides more details for the following alternatives.

Alternative 1 (Proposed Action)

Alternative 1 includes planting conifers on up to 21,300 acres, utilizing landscape position, Strategic Fire Management Areas and elevation to determine composition and density. Site preparation for planting includes: deep till and forest cultivation, mechanically removing or pile and burning dead material, manually applying herbicides, mastication, and prescribed fire (understory burning and jackpot burning). Release treatments include hand grubbing or manually applying herbicides (glyphosate) on up to 21,300 acres. Prescribed fire is proposed in new plantations within the first ten years. Deer habitat enhancement includes: planting conifers on up to 646 acres, monitoring 33 acres for natural regeneration, thinning 1,164 acres of existing plantation, and prescribed burning on 3,833 acres. Proposed natural regeneration includes monitoring 4,031 acres for conifer species composition and number of trees across the landscape to determine if site preparation, planting, release, and prescribed burning would occur. Alternative 1 includes understory burning and thinning on up to 12,769 acres within existing plantations (outside of Deer Enhancement areas). Noxious weed eradication is proposed on up to 5,714 acres.

Alternative 2 (No Action)

Alternative 2 (No Action) as required by the implementing regulations of NEPA, serves as a baseline for comparison among the alternatives (73 Federal Register 143, July 24, 2008; p. 43084-43099). Under Alternative 2, deer habitat enhancement, noxious weed eradication, reforestation (site preparation, planting conifers, release and reintroduction of prescribed fire) and thinning would not occur. Current management plans would continue to guide management of the project area.

Alternative 3

Alternative 3 responds to the significant issues and concerns identified through public scoping by proposing: additional human and native species health protections (no herbicides) and a different fuelbreak ridge treatment responding to the reforestation issue of fire hazard. Because no herbicides would be used for site preparation, release or noxious weed eradication, additional deep tilling and forest cultivation and manual grubbing treatments were added. Proposed reforestation includes a variable density planting design with more trees initially planted due to higher expected mortality. Noxious weed eradication is proposed on 3,131 acres, about one half of the acres proposed under Alternative 1.

Alternative 4

Alternative 4 responds to the significant issues and concerns identified through public scoping by proposing: considerably fewer planted acres and trees and the reintroduction of early and frequent use of prescribed and natural fire within and adjacent to these stands. Thousands of acres, proposed in Alternative 1, would not have initial mechanical fuels treatments and would remain unplanted in Alternative 4. Reforestation would occur on 2,867 acres using a founder stand planting design; small variable-shaped planted areas ranging from 2 to 10 acre in size that occupy about 20 percent of each unit. Release treatments include manually applying herbicides (glyphosate) on up to 4,012 acres. In addition, complex early seral forest is left intact and removed from reforestation consideration. Noxious weed eradication is proposed on 3,131 acres, about one half of the acres proposed under Alternative 1.

Alternative 5

Alternative 5 responds to the significant issues and concerns identified through public scoping by proposing: planting at a denser 7-foot by 14-foot spacing throughout deer habitat enhancement areas, natural regeneration units and reforestation units that include thinning into an open mosaic structure. This would result in a 6 to 8-foot by 12 to 16-foot spacing when applied on the ground at 444 trees per acre. Alternative 5 does not include prescribed fire post-planting in new plantations.

Alternatives Considered but Eliminated from Detailed Study

NEPA requires that federal agencies rigorously explore and objectively evaluate all reasonable alternatives and briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments and internal scoping suggested the alternatives briefly described below. Chapter 2.04 provides the reasons for eliminating them from detailed study.

a. Natural Succession

Allow the forest to recover naturally. This differs from “No Action” by including measures to thin existing plantations. Natural forest recovery occurs through recruitment of new populations from adjacent seed sources rather than planted seedlings.

b. Natural Regeneration with Founder Stands

Allow most of the forest to recover naturally. Outside complex early seral forest, plant founder stands: small variable-shaped areas less than 2 acres in size within a larger (10-acre total) area. On each of the 2 acres, plant 40 5-tree clusters spaced 6 feet between each tree and spaced 33 feet apart. Planting would not occur within 1,000 feet of an established conifer. On areas where no natural regeneration occurs, between 1,000 and 2,000 feet from established conifers, reforest 63 acres beginning 5 years after the 2013 Rim Fire. Only 20% of the 63 acres (i.e., 13 acres) would be planted.

c. Natural Regeneration with Founder Stands with tighter buffers

This alternative is similar to Alternative b (Natural Regeneration with Founder Stands) except for planting would not occur within 500 feet of established conifers. On areas between 500 and 1,000 feet from established conifers where no natural regeneration occurs, reforest 20% of 866 acres (173 acres) beginning 5 years after the 2013 Rim Fire using the founder stand guidelines. When natural regeneration is not occurring in areas greater than 1,000 feet from live conifer trees, reforest immediately to create founder stands on up to 20% of 47 acres (9 acres).

d. Low Density Planting (Plant 40 to 100 Trees per Acre)

This alternative would plant fewer trees per acre to provide an open pre-settlement condition.

e. Maximum Acres of Planting

Plant all possible areas identified on photos as lacking conifers. Forest recovery occurs through recruitment of new populations from planted augmentation.

f. One Herbicide Application

Glyphosate spraying would be limited to either a single site preparation treatment, and then rely entirely on hand grubbing or tree growth to out-perform competition, or to use alternative site preparation techniques coupled with a single herbicide release treatment in year 1 or 2 to give the newly planted tree a boost against competition.

g. Two Herbicide Applications

A maximum of two spray treatments would occur across every acre planted. This option would allow no more than one site prep treatment and one release treatment.

h. Spray Areas with 40% or More Bearclover (two applications)

Glyphosate would only be applied in stands where bearclover covered 40% or more of each acre to be planted or 40% of the overall planting unit. Where used to setback bearclover, glyphosate in this alternative could be applied for both site prep and for a single release treatment in the year chosen by Forest staff as most essential for survival based on field visits for a maximum of two applications.

Comparison of Alternatives

Table S.01-2 provides a summary comparison of proposed treatments under each alternative. Chapter 2.05 includes additional details.

Table S.01-2 Comparison of Alternatives: Proposed Treatments

Proposed Treatments (acres)	**Alternative 1** (Proposed Action)	**Alternative 2** (No Action)	**Alternative 3**	**Alternative 4**	**Alternative 5**
Deer habitat enhancement	3,833	0	3,833	1,164	3,833
Natural regeneration	4,031	0	4,031	22,464	0
Noxious weed eradication	5,714	0	3,131	3,131	5,714
Reforestation	21,300	0	21,300	2,867	25,331
Thin existing plantations	12,769	0	12,769	12,769	12,769
Prescribed fire only	0	0	0	34,344	0

Summary of Environmental Consequences

Table S.01-3 provides a summary comparison of effects for selected indicators under each alternative. Chapter 3 includes additional details.

Table S.01-3 Comparison of Alternatives: Summary of Effects for Selected Indicators

Resource and Indicator	**Alternative 1** (Proposed Action)	**Alternative 2** (No Action)	**Alternative 3**	**Alternative 4**	**Alternative 5**
Air Quality: Smoke emissions from broadcast and machine pile burning	Minimal effects to local communities and Yosemite.	Wildfire emissions would impact sensitive groups.	Same as 1.	Similar to 1, but more smoke from burning.	Same as 1.
Aquatic T&E: California red-legged frog; Sierra Nevada yellow-legged frog	Effects to habitat from ground disturbance, fire and herbicides. Effects to individuals highly unlikely due to probable absence.	No effects to individuals.	Similar to 1, but no herbicide use.	Similar to 1, but on fewer acres.	Similar to 1, but chance of increased sediment.
Aquatic Sensitive: Foothill Yellow-legged frog; Hardhead; Western pond turtle	Effects to habitat and individuals from ground disturbance, fire and herbicides.	No effects to individuals.	Similar to 1, but increased sedimentation and no herbicides.	Similar to 1, but on fewer acres and reduced herbicides.	Similar to 1, but chance of increased sediment.
Cultural Resources: Exposure and integrity of prehistoric and historic sites.	No effects due to following Rim PA and limited herbicide use in prehistoric sites.	Indirect effects on fragile sites from fire-weakened trees.	Similar to 1, but increased site prep may uncover unknown cultural sites.	Similar to 1, but reduced site prep and increased burning may impact historic sites.	Same as 1.
Fire and Fuels: Fire Behavior	Reduced fire effects in treated areas.	Indirect effects may create difficult wildfire behavior.	Same as 1.	Same as 1.	Same as 1.
Fire and Fuels: Strategic Fire Management Features	Beneficial effects from fuelbreaks, primary ridge treatments and emergency travel routes.	Indirect effects may create difficult fire management.	Similar to 1, but slightly less beneficial effects.	Same as 2.	Same as 1.
Invasive Species: Risk of Spread	Moderate	High	High	High	Moderate
Invasive Species: Eradication	High	None	Moderate	Moderate	High

Resource and Indicator	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3	Alternative 4	Alternative 5
Range: Impacts to range vegetation, administration, livestock movement and infrastructure	Short-term negative effects to vegetation and livestock movement. Long-term benefits from noxious weed control.	Indirect effects to vegetation, administration, livestock movement and infrastructure.	Similar to 1, but increased effects to livestock movement and no noxious weed control benefits.	Similar to 1, but no noxious weed control benefits.	Same as 1.
Recreation: Short-term loss of recreation opportunities	Short-term effects from herbicides; sights and sounds of machinery or workers; closures or travel delays; and, smoke.	None	Similar to 1, but longer impacts from machinery or workers.	Similar to 1, but diminished in scope.	Similar to 1, but with less smoke impacts.
Recreation: Long-term loss of recreation opportunity	Beneficial effects from increased forest resiliency and reduced wildfire risk. Recreation patterns may shift to other areas.	Indirect effects from weeds, wildfire risk and loss of shade in favorite areas.	Similar to 1, but increased effects on dispersed use.	Same as 1 in treated areas. Same as 2 in areas not treated.	Same as 1.
Sensitive Plants	May affect individuals, but is not likely to result in a trend toward federal listing or loss of species viability.	Same as 1.	Same as 1.	Same as 1.	Same as 1.
Society: Present Net Value	($75,134,000)	$1,871,000	($229,626,000)	($28,042,000)	($72,294,000)
Society: Total Jobs Supported (in FTEs)	2,369	0	7,764	283	2,302
Soils: Soil Stability	Increased short-term erosion risk. High EHR in 14% of treated areas.	Lowest short-term erosion risk. Low to Moderate EHR only.	Highest short-term erosion risk. High EHR in 22% of treated areas.	Similar to 2, but slightly higher erosion risk. High EHR in 2% of treated areas.	Similar to 1, but slightly higher erosion risk.
Soils: Surface Organic Matter and Soil Organic Matter (SOM)	Reduced surface organic matter. Short-term increase and possible long-term decrease in SOM.	None	Similar to 1, but most reduction in surface organic matter.	Similar to 1, but least reduction in surface organic matter (best cover) and least impact to SOM.	Similar to 1, but more surface organic matter.
Special Areas: Wilderness Character	Short-term effects from drift smoke and sights and sounds of machinery or workers near Wilderness boundary.	None	Same as 1.	Similar to 1, but more smoke impacts.	Similar to 1, but less smoke impacts.
Vegetation: Average conifer DBH at year 20 (inches)	4.3	1.7	2.8	1.9	4.3
Vegetation: Average conifer height at year 20 (feet)	23.2	12.4	16.3	13.1	23.6
Vegetation: Future potential timber yield (million board feet)	163	42	48	42	160

Resource and Indicator	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3	Alternative 4	Alternative 5
Watershed: Erosion and Sedimentation (Thinning and Site Preparation Activities)	Creation of sediment transport networks.	No new sediment transport networks created; hydrological and erosional responses to the Rim Fire would still occur; existing skid trail sediment transport networks remain.	Slight increase in ground disturbance and the potential of erosion and sediment delivery to streams 1.	Dramatic reduction in the creation of effective sediment transport networks. Much less potential for erosion and sedimentation than 1.	Same as 1.
Watershed: Riparian Vegetation	Slight beneficial effects to riparian obligate species, SAFs and meadows.	No disturbance to riparian species. Indirect effects from lack of sunlight and weed control.	Similar to 1, but less weed control.	Same as 3.	Same as 1.
Watershed: Stream Condition	Beneficial effects from restoration improving hillslope and riparian functions.	Indirect effects from continued loss of hillslope and riparian functions.	Same as 1.	Similar to 1, but on fewer acres.	Same as 1.
Watershed: Water Quality (Beneficial Uses of Water)	No effects to water temperature or beneficial uses. Beneficial effects from accelerated return to conifer forest. Low potential for herbicides to contaminate water.	None	Similar to 1, but no herbicides.	Similar to 1, but less return to conifer forest and herbicides.	Same as 1.
Wildlife T&E: Valley elderberry longhorn beetle	May affect but is not likely to adversely affect; will not affect Designated Critical Habitat.	Same as 1.	Same as 1.	Same as 1.	Same as 1.
Wildlife Proposed T&E: Fisher	May affect but is not likely to jeopardize continued existence.	Same as 1.	Same as 1.	Same as 1.	Same as 1.
Wildlife Sensitive: Bald eagle; California spotted owl; Great gray owl; Northern goshawk; Pacific marten; Pallid bat, fringed myotis, and Townsend’s big-eared bat; Western Bumble Bee	May affect individuals but is not likely to result in a trend toward federal listing or loss of viability.	Same as 1.	Same as 1.	Same as 1.	Same as 1.
Wildlife: Black-backed woodpecker	Retains 76 percent of modeled pairs.	Retains 100 percent of modeled pairs.	Same as 1.	Same as 2.	Same as 1.
Wildlife: Mule deer	Improves 7,000 acres of critical winter deer range.	No improved critical winter deer range.	Same as 1.	Improves 3,200 acres of critical winter deer range.	Same as 1.

1. Purpose of and Need for Action

The Forest Service prepared this Environmental Impact Statement (EIS) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This EIS discloses the direct, indirect and cumulative environmental impacts that would result from the proposed action and alternatives.

1.01 Document Structure

The document is organized into the following chapters and sections:

- **Chapter 1** (Purpose of and Need for Action): briefly describes the proposed action, the need for that action, and other purposes to be achieved by the proposal. It also details how the Forest Service informed the public of the proposed action and how the public responded.
- **Chapter 2** (The Alternatives): provides a detailed description of the proposed action as well as alternatives developed in response to comments raised by the public during scoping and information gained after the formulation of the proposed action and public scoping period. It includes a summary comparison of the action and effects of the alternatives.
- **Chapter 3** (Affected Environment and Environmental Consequences): describes the environmental impacts of the proposed action and alternatives.
- **Chapter 4** (Consultation and Coordination): provides a list of preparers and others consulted during the development of the EIS.
- **Index**: provides page numbers by document topic.
- **References**: provides a list of references and literature cited in the EIS.
- **Appendices**: provide more detailed information to support the analyses presented in the EIS.
- **Map Package**: the separate map package includes large scale maps showing treatment units and noxious weed areas by Alternative (2. Alternatives).

Additional documentation, including detailed analyses of project area resources, may be found in the project record located at: Stanislaus National Forest; 19777 Greenley Road; Sonora, CA 95370.

1.02 Background

The Rim Fire started on August 17, 2013 in a remote area of the Stanislaus National Forest near the confluence of the Clavey and Tuolumne Rivers about 20 miles east of Sonora, CA. Exhibiting high to extreme fire behavior with multiple flaming fronts, the fire made runs of 30,000 to 50,000 acres on two consecutive days. It quickly spread up the Tuolumne River watershed and its main tributaries: Clavey River, North Fork Tuolumne, Middle Fork Tuolumne, South Fork Tuolumne and Cherry Creek. It also overlapped into the North Fork Merced River. Overall, 98% of the Rim Fire occurred in the Tuolumne River watershed. Over several weeks it burned 257,314 acres, or 400 square miles including 154,530 acres of National Forest System (NFS) lands.

The fire also burned within Yosemite National Park (78,895 acres), Sierra Pacific Industries private timberland (16,035 acres), other private land (7,725 acres) and Bureau of Land Management (BLM) land (129 acres)[1].

The Rim Fire is the third largest wildfire in California history and the largest wildfire in the recorded history of the Sierra Nevada. It is also California's largest forest fire, burning across a largely conifer dominated forest landscape. The two larger fires were wind driven brush fires near San Diego in 2003 and in Lassen County in 2012.

The Rim Fire burned between 1,000 to 7,000 feet in elevation in a mixed severity mosaic pattern through all its principal vegetative communities. The fire impacted a range of California Wildlife Habitat Relationships (CWHR) vegetation types including grass-oak woodlands, chaparral, lower westside ponderosa pine, mixed conifer forests and high elevation true fir and lodgepole pine. Figure 1.02-1 shows an example of the mosaic burn pattern created by the fire. Reforestation is proposed within and adjacent to areas that were salvage logged or had fuels treatments under the Rim Recovery EIS, within burned 15-to 40-year-old existing plantations and large areas where conifer stocking is low and the site is capable, available and suitable for conifer growth. The mosaic pattern of the fire resulted in areas of high, moderate and low vegetation burn, and reforestation focuses on areas where few if any conifers survived to provide forest cover to meet desired future conditions.

Figure 1.02-1 Rim Fire view shows mosaic of vegetation burn severity with different reforestation needs

Project Location

The Rim Fire Reforestation (Rim Reforestation) project is located within the Rim Fire perimeter within portions of the Mi-Wok and Groveland Ranger Districts on the Stanislaus National Forest (T3N-T2S, R16E-R19E; MDBM). The project area includes all NFS lands within the fire. It does not include Wilderness or any private, state or other federal lands.

Figure 1.02-2 shows the location of the Rim Fire within the boundaries of the Stanislaus National Forest, Yosemite National Park and the local counties (Mariposa and Tuolumne).

[1] All acreage figures are based on fire perimeter and land ownership information as of October 24, 2013.

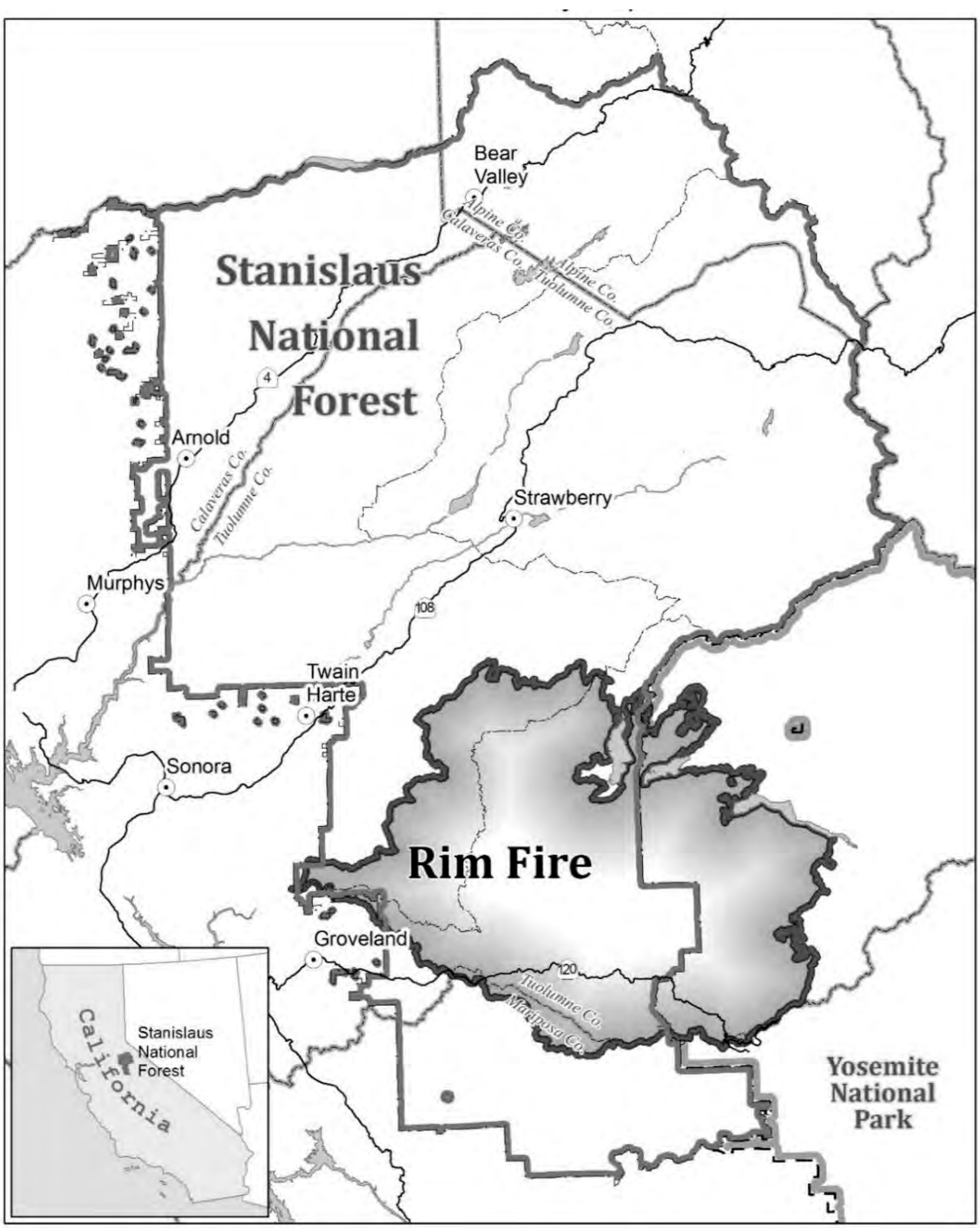

Figure 1.02-2 Rim Fire Vicinity Map

Forest Plan Direction

The Forest Service completed the Stanislaus National Forest Land and Resource Management Plan (Forest Plan) on October 28, 1991 (USDA 1991). The Stanislaus National Forest "Forest Plan Direction" presents the current Forest Plan management direction, based on the original Forest Plan, as amended (USDA 2010a). The Forest Plan Compliance Checklist (project record) provides additional details.

The Forest Plan includes Goals, Strategies and Objectives for this project (p. 5-7 and 11-15). The following key goals and objectives guided project development.

Aquatic, Riparian, and Meadow Ecosystems and Associated Species: Maintain and restore habitat to support viable populations, spatial and temporal connectivity for aquatic and riparian species, water quality and desired physical structures and conditions of streams.

Diversity: Maintain or increase diversity of plants and animals, with a balance of vegetation types currently represented on the Forest which best provide for meeting the resource goals and objectives of the Forest Plan.

Fire and Fuels: Provide a cost-effective fire management program to protect Forest resources, life and property from the effects of wildfire. Maintain natural and activity fuels at levels commensurate with minimizing resource losses from wildfire. Strategically place treatment areas across landscapes to interrupt potential fire spread.

Fish and Wildlife: Provide habitat for viable populations of all native and desired non-native wildlife, fish and plants. Maintain and improve habitat for Threatened and Endangered species and give special attention to sensitive species to see that they do not become Federally listed as Threatened or Endangered.

Noxious Weed Management: Prevent the introduction of new invaders; conduct early treatment of new infestations; and, contain and control established infestations.

Old Forest Ecosystems and Associated Species: Restore forest species composition and structure following large scale, stand-replacing disturbance events.

Water: Maintain or improve water quality and watershed condition to meet applicable state and federal requirements. Realize feasible increases in the quantity of water yield and delays in the timing of runoff by including water yield modification as an objective in the design and manipulation of commercial and non-commercial vegetation.

Strategy

An event as large as the Rim Fire provides an opportunity to look at restoration at a landscape scale, and to consider the many features and structures that are desirable and sustainable for future forested conditions. The Forest Plan long-term management goals include goals to create a fire resilient forest with a more historic heterogeneous structure where fire is an integral part of the system, not a landscape altering force (USDA 2010a, p. 5-15). To sustain forests into the future, natural and prescribed fire will be an important tool to protect this area from another landscape-altering event. To that end, Forest Service Fire and Fuels staff from the Stanislaus and Pacific Southwest Research Station compiled a strategy for the Rim Fire area outlining conditions along with features on the landscape that could help reduce the size and severity of future fires.

As a component of this strategy, Fire Emphasis Areas were mapped for the entire burned area as Strategic Fire Management Features (emergency travel routes and fuelbreaks) and Strategic Fire Management Areas (large blocks of land where lower density forest would be found adjacent to critical areas). The Fire Emphasis Areas strategy was used to identify key areas across this landscape as well as guiding planting and thinning patterns and densities. Other strategy conditions include heterogeneous forest structure throughout the area (clumped and variable spaced trees), limited amounts of trees in plantations on southern and southwestern slopes where natural fire return intervals are high and the tree growing ability is low and prescribed and natural fire occurs within stands every 5 to 20 years.

Reforestation would be focused on areas that are best suited to support a forest and be more resilient when the next fire comes. One of the primary goals of the strategy is to reintroduce fire and/or to let natural fire back into proposed and existing plantations as soon as possible in order to ensure the long-term existence and viability of this new forest and to follow-up with fuel maintenance treatments. The Forest Service recognizes that fire will occur here again and setting up a fire-resilient landscape is critical.

In March 2009, PSW released General Technical Report 220, "An Ecosystem Management Strategy for Sierran Mixed-Conifer Forests" (GTR 220) (North et al. 2009). GTR 220 emphasized the importance of learning from historic conditions to determine sustainable desired conditions. This report summarized recent scientific literature suggesting that land managers produce different stand structures and densities across the landscape using topography and historic fire behavior to guide treatments. Historically, both topography and fire influenced forest structure and composition in the Sierra Nevada. Management that creates and mimics those historic stand structures and fire-mediated processes will help restore the natural role of fire on the landscape, create structural heterogeneity at multiple scales, and improve habitat quality by providing multilayered canopies and other key structures associated with sensitive wildlife species, such as the Pacific fisher, California spotted owl, and northern goshawk.

Forest Service direction and intent, recent science summarized by GTR 220, and the Rim Fire Vegetation Resiliency Strategy (project record) provided an extensive foundation of information to draw from during the Rim Reforestation planning effort. The analysis in this document focuses on restoring ecosystem function, process, and resiliency by addressing issues related to vegetative composition and structure, forest health, fuels, hardwood and wildlife habitat improvement, and socio-economic objectives. Although these are long-term goals, how and where reforestation is conducted, if done at all, will set the stage for future activities in this area and provide some habitat components within the burn that will not naturally be available for decades.

The Rim Fire is not the first wildfire that occurred in this area. Since 1944, 20 large fires burned fully or partially within the Rim Fire area leaving portions of the area now burned up to four times over that period. Figure 1.02-3 shows the large fire history of this wildfire dominated landscape.

Relation to Other Rim Fire Projects

The Rim Fire Hazard Tree (Rim HT) project and the Rim Fire Recovery (Rim Recovery) project began the Rim Fire restoration process. Rim HT is essentially complete and Rim Recovery is about 70% complete and implementation will continue regardless of the decision that is made for the Rim Reforestation project. This EIS considers the effects of the initial two projects as part of the existing condition in the cumulative effects analysis (Appendix B).

The Rim Fire Rehabilitation (Rim Rehabilitation) and Rim Fire Habitat Improvement (Rim Habitat) Decision Memo projects were also completed to address the repair or improvement of habitat and natural resources, including wildlife and sensitive plants, and the protection and improvement of meadow, stream, and spring functions. The Rim Reforestation project treatment areas do not overlap with those from the Rim Rehabilitation and Rim Habitat projects. Therefore, while this EIS considers the effects of the previously analyzed Rim projects as part of the cumulative effects analysis, they are not connected actions under the Council on Environmental Quality (CEQ) NEPA regulations (40 CFR 1508.25 (1)).

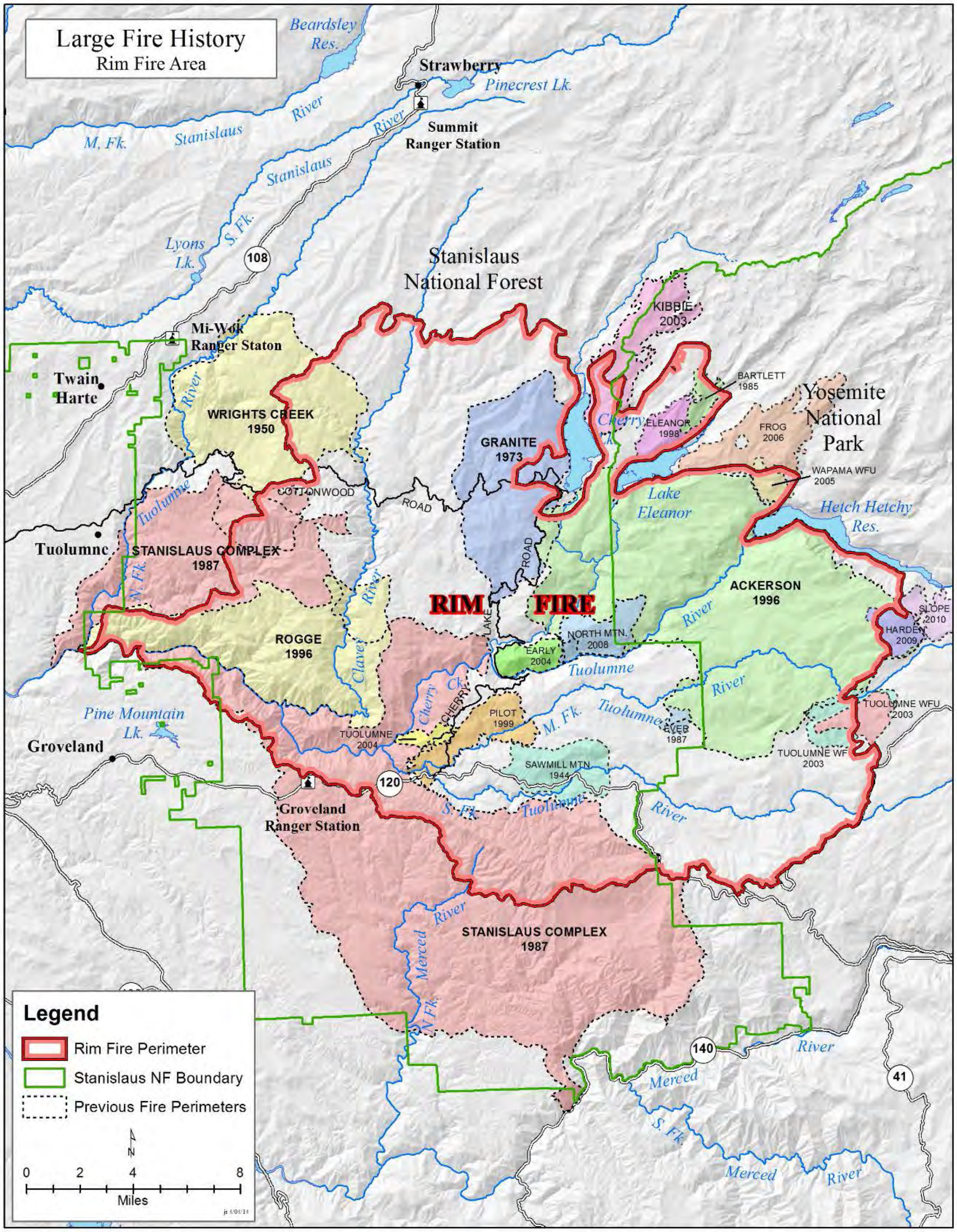

Figure 1.02-3 Large Fire History Map

Much of what happens with future restoration actions will depend on information that is simply unavailable at this point, and may not be known for months, or even years. Because the Rim Reforestation project has independent utility and may proceed regardless of whether future agency actions occur within the Rim Fire area, the future actions and this project are not connected actions under the CEQ NEPA regulations. Furthermore, because none of the future actions have reached the stage of being "identified proposals" that can be meaningfully evaluated, those future actions do not meet the definition of "reasonably foreseeable future actions" in the Forest Service NEPA regulations (36 CFR 220.3, 220.4(a)(1)). Therefore, additional future restoration and recovery actions are not included in the cumulative effects analysis for this project. If there are cumulative effects arising from future projects in combination with the residual effects of this project, those cumulative effects will be considered as part of the environmental effects analysis for those future projects, to the extent required by NEPA.

1.03 Purpose and Need

The Interdisciplinary (ID) team identified the following purpose and needs for the Rim Reforestation project.

Purpose

Based on the Forest Plan Direction, the overall purpose of the Rim Reforestation project is to: ***create a fire resilient mixed conifer forest that contributes to an ecologically healthy and resilient landscape rich in biodiversity***.

Several sensitive wildlife species lost critical habitat when the Rim Fire burned extensive amounts of mature trees. Large amounts of those dead trees remain. Providing opportunities to re-establish forests is critical to sustain populations and for connectivity of habitat for wildlife movement and expansion. Without mature live trees to provide a seed source within close proximity to the burned areas, or the lack of a viable and healthy cone crop, natural conifer regeneration cannot be counted on within large portions of the Rim Fire. In addition, brush is already beginning to dominate sites, inhibiting conifer survival and growth. Conifer seed dispersal is often sporadic in nature (Shatford et al. 2007). Research in the Sierra Nevada shows that it can take 30 to 50 years for conifers to establish among dense sprouting shrubs following high-severity wildfire (Russell et al. 1998). Once established, the intense competition with sprouting vegetation for light and water results in slow seedling development (Shatford et al. 2007). Nagel and Taylor (2005) estimated that on average it took 30 years for white fir seedlings to grow one foot in height when growing among shrubs; and, about 120 years of fire suppression for white fir to establish and overtake chaparral vegetation.

The Larson Fire portion of the 1987 Stanislaus Complex Fire displays similar trends where over 13,000 acres of productive mixed-conifer forest was severely burned and never reforested. After 10 years, sprouting vegetation still dominates about 85% of the area (USDA 2004b). Today, almost 30 years after the fire, conifer encroachment is negligible. Without intervention much of the uncharacteristically large high-severity patches of the Rim Fire will persist as continuous woody brushfields that over time become so dense that they impede wildlife movement and significantly delay if not remove the possible establishment of diverse mixed-conifer forest habitat. The brushfields, along with the dead trees that fall among them, can also quickly spread high intensity fire. Under these situations, natural conifer regeneration resulting in a forested landscape could take hundreds of years to develop. Figure 1.03-1 shows an example of an area burned in the same fire with an unplanted brushfield adjacent to actively reforested land where the prescription included mechanical site preparation followed by herbicide release and inter-planting. While the planting density and pattern in the example significantly differ from that proposed in this project, it demonstrates the ability to accelerate succession from chaparral to conifer forest.

Figure 1.03-1 2014 view of private land (brush) and NFS land planted in 1993

The desired mature forest structures include: shaded fuelbreaks along key roads and strategic locations; large blocks of forest with lower tree densities adjacent to critical areas (i.e. private property and old forest emphasis areas); heterogeneous forest structure throughout the area (a mix of tree species, sizes, and spacing); and prescribed and natural fire within these stands within the first 10 years with a 5 to 10 year fire return interval. Such features located across the landscape provide areas where fire can be slowed or stopped and provide safe locations for firefighters to work from during wildfires and to utilize during prescribed burning activities (Johnson et al. 2013).

In general, the desired future stand densities range from moderately to lightly forested along ridge tops and south aspects. Openings are generally less than 0.25 acres mimicking historic conditions. Dense high canopy cover stands are found in drainage bottoms, riparian areas and bottom portions of northeast facing slopes with riparian vegetation and conifers shading creeks. Riparian areas have the greatest amounts of large woody material. Openings are small and of the lowest spatial frequency in the moister areas. High to moderate stand densities and canopy cover is desired mid-slope on north-northeast aspects with higher gap frequency and size compared to drainage bottoms, decreasing in density and increasing in openness with progression upslope. South-southwest facing slopes are more open with lower tree densities than northeast aspects and drainage bottoms. These drier south facing slopes have the most drought tolerant tree species (ponderosa pine), with fewer trees per acre, open stand conditions and more frequent and larger gaps than northeast aspects. Ridgetops and upper southwest positions have the lowest tree densities and most drought tolerant species (ponderosa pine).

Desired Future Conditions

The desired future conditions described below are based on Forest Plan Direction and input from the public, the ID team, and a group of resource specialists representing major forest management disciplines. This desired landscape would have an increased capacity to adapt and survive natural disturbances, especially under changing and uncertain future environmental conditions, such as those driven by climate change and human use. This project looks at the short-term (up to 10 years) by proposing activities that incrementally move toward these long-term (60 to 100 years) goals, returning healthy vigorous trees in a mosaic of forest conditions across the landscape.

OLD FOREST MOSAIC

The desired long-term (60 to 100 years) Old Forest Mosaic condition is heterogeneous Sierran mixed-conifer forest based on topographically driven variations in plant water availability (North et al. 2009). Moderate to high stand densities, a greater proportion of large clumps and generally small openings characterize this area. The desired condition consists of Old Forest Emphasis Area (USDA 2010a, p. 190) characteristics with high levels of horizontal and vertical diversity composed of roughly even-aged vegetation groups varying in size, species and structure. It contains patches of large trees, an average of 60% to 80% canopy cover and diverse multi-layered canopy and vegetative species.

OPEN CANOPY MOSAIC

The desired long-term Open Canopy Mosaic forest condition is heterogeneous stands tolerant of high frequency low-to-mixed intensity fire with emphasis on fire resiliency. When compared with Old Forest Mosaic, a larger proportion of individual trees and small clumps with large and frequent openings, characterize this area. The primary desired condition is widely spaced and highly drought tolerant ponderosa pines and oaks on south facing slopes and ridge tops. Mixed species are present in drainages. Average canopy cover ranges from 40% to 50%. These conditions support the fire and fuels objectives while maintaining wildlife habitat and connectivity across the landscape. Fire hazard, Strategic Fire Management Areas, wildlife habitat needs, topographic position and soil characteristics guide the relative proportion of open stand density, canopy cover and opening size and frequency within Open Canopy Mosaic units.

DEER EMPHASIS

The desired long-term Deer Emphasis condition is a heterogeneous mosaic of forested and high quality forage habitat throughout the mule deer winter range and migration corridors, tolerant of low-to-mixed severity fire. Forest areas, primarily ponderosa pine, are found in close proximity, but separated from oaks, a primary emphasis within these units. Forest habitat is comprised of both hiding and thermal cover. Hiding cover is designed to conceal deer from predators and consists of open stands with a canopy cover less than 50% in discrete locations up to 25 acres in size. Thermal cover is designed to provide protection from inclement weather and consists of denser stands with an average canopy cover of 60% or greater in discrete locations up to 5 acres in size.

Needs

The following 5 needs are based on Forest Plan Direction, the overall purpose to ***create a fire resilient mixed conifer forest that contributes to an ecologically healthy and resilient landscape rich in biodiversity*** and desired future conditions for Old Forest Mosaic, Open Canopy Mosaic and Deer Emphasis.

1. Return Mixed Conifer Forest to the Landscape

Promote the re-establishment and restoration of conifer forests with diverse structure and composition to quickly meet future resource needs for wildlife, recreation, watershed and timber while taking into account potential pressures of a changing climate. The overall goal is to re-establish a conifer forest in an effort to contribute to an ecologically healthy and resilient landscape rich in biodiversity. This landscape would have an increased capacity to adapt and survive natural disturbances, especially under changing and uncertain future environmental conditions, such as those driven by climate change and human use. This project looks at the short-term (up to 10 years) proposing activities that incrementally move toward these long-term (60 to 100 years) goals, returning healthy vigorous trees in a mosaic of forest conditions across the landscape. (Old Forest Mosaic, Open Canopy Mosaic and Deer Emphasis Desired Future Conditions)

2. Restore Old Forest for Wildlife Habitat and Connectivity

Restore old forest composition and structure to provide critical habitat for sensitive wildlife species such as the California spotted owl, northern goshawk and fisher. This includes restoring habitat connectivity compromised in the Rim Fire that is essential for wildlife dispersal, migration, and use of suitable habitat across the landscape. (Old Forest Mosaic Desired Future Condition)

3. Reduce Fuels for Future Fire Resiliency

Reduce the fuel load that exists from standing dead trees and re-sprouting brush, including portions of the burned area within existing older plantations. Re-establish open canopy forest stands to safely reintroduce fire into the landscape through fuels and vegetation management. (Open Canopy Mosaic Desired Future Condition)

4. Enhance Deer Habitat

Restore forested conditions within critical winter deer range, providing thermal cover essential for over-wintering deer. (Deer Emphasis Desired Future Conditions)

5. Eradicate Noxious Weeds

Prevent new infestations of noxious weeds and the spread of existing weeds as the result of project activities. Reduce the quantity and extent of noxious weeds, and manage their adverse impacts on ecosystem structure and function, contribution to fine fuels, competition to young seedlings and impacts to biodiversity and native plants. (Old Forest Mosaic, Open Canopy Mosaic and Deer Emphasis Desired Future Conditions)

Project Development

Historically, wildfire and topography interacted with vegetation, creating an array of tree spatial patterns (or structures) that can be categorized into three primary components: individual trees, tree clumps and openings, referred to as ICO (Churchill et al. 2013; Lydersen et al. 2013). Lydersen et al. (2013) studied historic stand structures from the Stanislaus Tuolumne Experimental Forest, just north of the Rim Reforestation project area. Table 1.03-1 shows the historic data indicated that more frequent fire was likely associated with a greater proportion of the trees being shade-intolerant pine existing as individuals and in small clumps, while periods of less frequent fire allowed for ingrowth of shade-tolerant species that resulted in higher proportions of the trees existing in large clumps with higher tree densities.[2]

Gap sizes, or forest openings, within a stand can also vary depending on the extent, severity and frequency of disturbances. In the case of mixed-severity fire, tree mortality can be isolated to individual trees or large patches of trees. In the Rim Fire high severity patches were uncharacteristically large and accounted for a larger proportion (35%) of the burned area than historically occurred (Miller et al. 2009). Lydersen et al. (2013) defined the minimum size for gaps as being an opening in the canopy that is comparable in size to the area dominated by a large tree crown. Table 1 shows the range of gap sizes that occurred at the Stanislaus-Tuolumne Experimental Forest. While the majority of these gaps were smaller and likely influenced by factors such as low to moderate severity disturbances and stand development dynamics, some larger gaps likely occurred as a result of high-severity fire. In yellow pine and mixed conifer forests, historic mean high-severity

[2] Assumes that the 1929 ≥ 10 inch and 1929 ≥ 4 inch datasets are representative of time since the last fire. That is, more small trees (4-10 inches) are likely to establish during longer periods without fire. Lydersen et al. (2013) gives further explanation. Assumption is also based on an estimated average fire return interval of 5 years with a range of 1 to 40 years in similar forest types throughout the Sierra Nevada (Mallek et al. 2013).

patch sizes ranged from 4.2 to 22.5 acres with the majority of the high-severity patches being less than 10 acres (Collins and Stephens 2010; Miller et al. 2012; Mallek et al. 2013). Larger mean patch sizes were associated with fir-dominated areas, while pine-dominated areas were more likely to experience smaller (<15 acres) mean high-severity patches (Collins and Stephens 2010).

The Forest Service proposed action is guided by the purpose and need, reflecting multiple approaches to begin developing the desired future condition. The approaches include using various reforestation techniques (e.g., site preparation, planting and release from vegetative competition), actively managing residual plantations (thinning to create an ICO structure and favoring a diversity of species) and promoting natural regeneration where it occurs. Existing conditions, fire potential, long-term wildlife habitat needs and topography helped identify and prioritize treatment areas.

The interdisciplinary team of resource specialists (ID team) spent months developing the proposed planting strategies and working with interested publics, attempting to balance short and long-term goals. The team looked at planting in various clump and spacing configurations, but found that too few trees per acre would be initially planted in the proposed Old Forest Mosaic areas where the desired canopy cover is 60% to 80%. Only by "clumping" trees 1 to 2 feet apart can higher numbers be reached, requiring removal in a pre-commercial thin (a situation the ID team wanted to avoid) if all trees in a cluster survive. Instead, the ID team looked at several planting scenarios with a typical spatial pattern (i.e. 14 feet by 14 feet) allowing for desired canopy cover to be reached sooner in these Old Forest Mosaic stands. To break up the spatial continuity, the team is proposing several different sized buffers around oaks, roads, riparian vegetation and meadows in addition to no-plant areas such as sensitive plant and research sites. Where future desired canopies are 40% to 50% in the Open Canopy Mosaic areas, the Forest Service is proposing a variable clumped and spaced planting design, focusing on structure or open spacing between crowns to allow for more effective fire management in these stands.

Table 1.03-1 Structural characteristics of single trees, small, medium and large clumps

Structure	Recently Burned	40 Years Since Last Fire
Single Trees		
Singles per acre	6.7	7.3
Proportion of trees (%)	12.6	5.6
Nearest neighbor distance (feet)	28.5	21.0
Small Clumps (2 to 4 trees)		
Clumps per acre	5.8	5.9
Proportion of trees (%)	30.4	13.4
Nearest neighbor distance (feet)	11.2	9.2
Medium Clumps (5 to 9 trees)		
Clumps per acre	2.0	2.9
Proportion of trees (%)	23.5	14.8
Nearest neighbor distance (feet)	10.2	6.6
Large Clumps (10 to 33 trees)		
Clumps per acre	1.3	2.8
Proportion of trees (%)	33.5	66.2
Nearest neighbor distance (feet)	10.2	6.6
Gap Frequency Per Acre		
0.03 to 0.06 acre gaps	0.9	1.3
0.06 to 0.12 acre gaps	0.7	0.4
0.12 to 0.25 acre gaps	0.3	0.4
Greater than 0.25 acre gaps	0.5	0.1

Source: Lydersen et al. 2013

It is also important to note that 10,635 acres of potential conifer forestland are not being proposed for any reforestation treatment for the following reasons: 1) areas were too steep for mechanical treatment and the competing vegetation too tall to treat by hand; 2) the number of acres burned fall within the historical range of natural variability (contiguous openings without live trees were less than 22 acres in size); 3) areas are surrounded by green and mature trees with natural regeneration very likely to occur; 4) ongoing research projects; 5) fire management objectives and goals; and 6) some deer emphasis areas where oak is the desired dominant species. In addition, 13,934 acres of plantations planted during the 1970s through the 1990s survived the Rim Fire with limited mortality. These older plantations were planted in a range of 8 feet by 8 feet (680 trees per acre) to 10 feet by 10 feet (435 trees per acre) without regard for existing oaks, residual green trees or natural regeneration, and many were inter-planted to ensure full site occupancy. These plantations with their well-established trees provide an excellent opportunity to create the desired ICO structure and the Forest Service is proposing thinning to accomplish this long-term goal.

1.04 PROPOSED ACTION

This is the Proposed Action, as described in the Notice of Intent (80 Federal Register 39, February 27, 2015; p. 10663-10664), with corrections based on updated data and map information. The Forest Service proposed action includes about 42,000 acres of deer habitat enhancement, natural regeneration, noxious weed eradication, reforestation, thin existing plantations and associated management requirements on NFS lands within the 2013 Rim Fire (Figure 1.04-1). Chapter 2.02 includes a detailed description of this proposal under Alternative 1 (Proposed Action). No treatments are proposed within Wilderness, Inventoried Roadless Areas, or the Wild classification segments of Wild and Scenic Rivers or Proposed Wild and Scenic Rivers. Project design will incorporate Best Management Practices (BMPs) according to regional and national guidance. It is anticipated site preparation would begin as soon as fall 2016 and treatments would continue for up to 10 years.

Deer Habitat Enhancement

Deer Habitat Enhancement treatments (3,833 acres) include: reforestation; prescribed burning; thinning; and, noxious weed eradication within this critical deer area.

Natural Regeneration

Natural Regeneration treatments (4,031 acres) include: utilizing an adaptive management approach, monitor these units to determine if the area has sufficient natural regeneration (a minimum of 300 trees per acre well dispersed across the unit). Reduce fuels on these sites where amounts exceed the fire and fuels management requirements (10 to 20 tons per acre depending on location). If natural regeneration is not adequate after five years in regards to the species and number of trees, then complete site preparation, plant and release treatments, as described under reforestation. Release treatments may be used if initial regeneration is successful, but brush species start dominating the site.

Noxious Weed Eradication

Noxious Weed Eradication treatments (5,714 acres) include the following Environmental Protection Agency (EPA) approved herbicides: Glyphosate; Clopyralid; Aminopyralid; and, Clethodim. These noxious weed treatments either overlap or are adjacent to the reforestation, plantation thinning or deer habitat enhancement areas described.

Reforestation

Reforestation treatments (21,300 acres) include: manual application of herbicides (Glyphosate) and hand and mechanical site preparation; prescribed burning; planting a diversity of conifer tree species using various patterns and densities (trees per acre) across the landscape (up and down slopes, with fewer on ridges and more in drainage bottoms) to develop a resilient mixed conifer forest and enhance wildlife (including deer) habitat; manual herbicide release (Glyphosate) when vegetation competition begins to inhibit survival and growth; and, noxious weed eradication as described above.

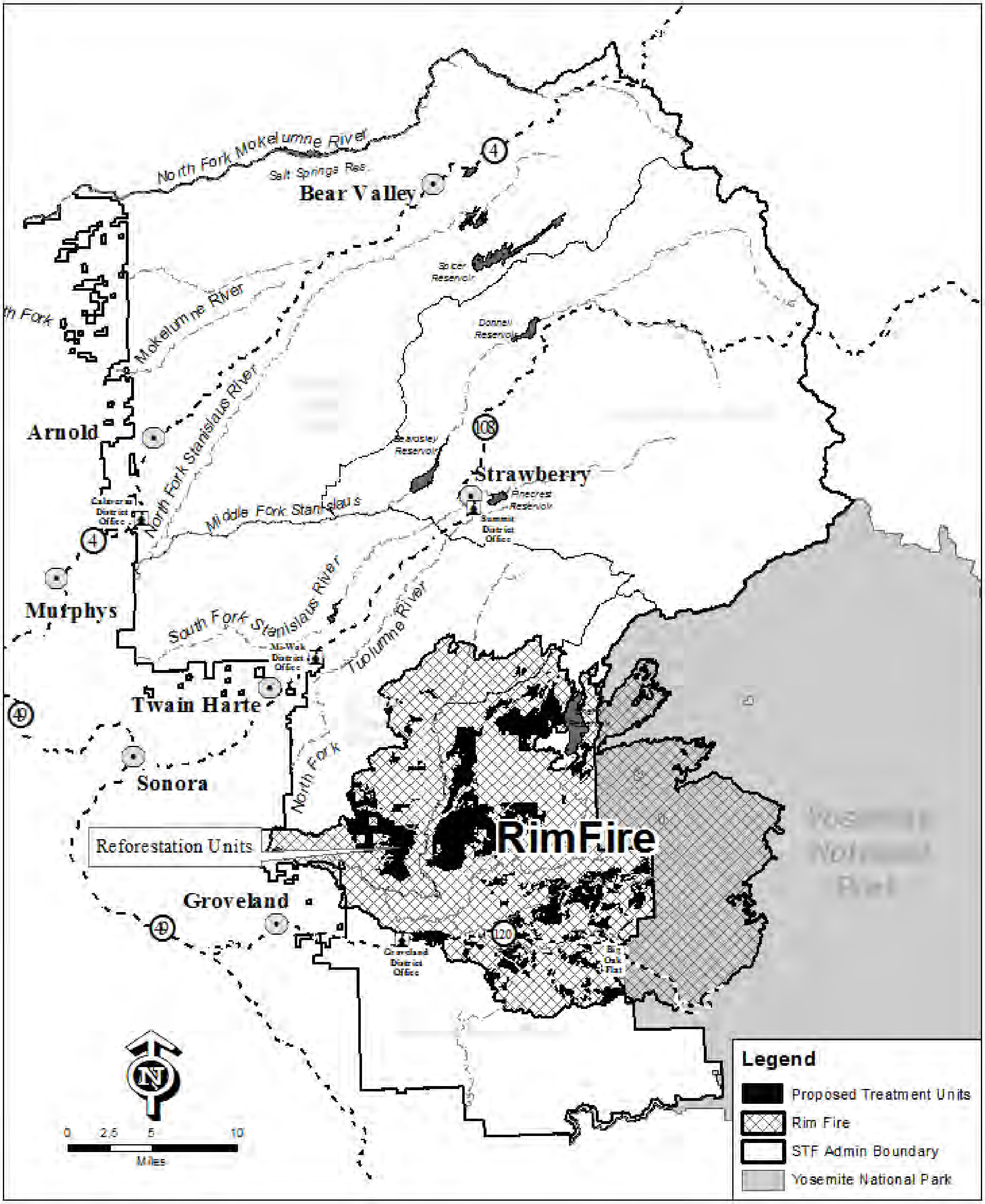

Figure 1.04-1 Rim Fire Reforestation Proposed Action Treatment Units

Thin Existing Plantations

Thin existing plantation treatments (12,769 acres) include hand and mechanical treatments to achieve the ICO pattern to maximize heterogeneity and wildlife (including deer) habitat while creating more fire resilient stands. Prescribed burning to reduce ground fuels within these plantations would be done prior to hand or mechanical operations in order for any tree mortality to be utilized in creating the ICO structure during those treatments.

Proposed Action Maps

Detailed maps are available by request or online at: http://www.fs.usda.gov/project/?project=45612:

Map 1 - Desired Future Condition Alternatives 1, 3, 4 and 5

Plotter size (42 inch by 60 inch) map showing desired future conditions and fire emphasis areas.

Map 2 - Proposed Treatment Alternatives 1, 3 and 5

Plotter size (42 inch by 60 inch) map showing treatments (adaptive management; deer enhancement; natural regeneration; reforestation; and, thinning).

Map 4 - Noxious Weed Treatment Alternatives 1 and 5

Plotter size (42 inch by 60 inch) map showing invasive plant sites identified for noxious weed eradication.

Updates to the Proposed Action

The Forest Service updated the proposed action based on subsequent field information and surveys. The updated proposed action differs from the original scoping package (Scoping) with most changes in relation to additional field data collection. The way the treatments are displayed also changed from the scoping package in order to more clearly identify the proposed treatments, their locations and purpose. Table 1.04-1 displays and compares the Proposed Action from Scoping with the updates identified for Alternative 1 (Proposed Action) in this EIS.

Table 1.04-1 Updates to the Proposed Action

Action	Treatment	Proposed Action (Scoping)	Alternative 1 (Proposed Action)
Deer Habitat Enhancement	Planting, underburning, thinning and noxious weed eradication	481	3,833
Natural Regeneration	Monitoring and adaptive management	0	4,031
Noxious Weed Eradication[1]	Manually apply herbicides	4,963	5,714
Reforestation	Site preparation, plant and release	30,065	21,300
Thin Existing Plantations	Hand or mechanical tree removal	11,285	12,769
Overall Treatments (acres)		46,794	47,666

[1] Noxious weed eradication treatments overlap and are not additive. Alternative 1 noxious weed treatment acres changed from 5,915 acres in the DEIS to 5,714 in the EIS due to a mapping correction for Sulphur cinquefoil (Table 3.06-1).

1.05 Principal Laws and Regulations

NEPA requires that all major federal actions significantly affecting the human environment be analyzed to determine the magnitude and intensity of those impacts and that the results be shared with the public and the public given opportunity to comment. The regulations implementing NEPA further require that to the fullest extent possible, agencies shall prepare EISs concurrently with and integrated with environmental analyses and related surveys and studies required by the Endangered Species Act of 1973, the National Historic Preservation Act of 1966, and other environmental review laws and executive orders. Other laws that apply to this project include: the Multiple Use and Sustained Yield Act of 1960; the National Forest Management Act of 1976; the Clean Air Act of 1990; the Clean Water Act of 1972; and, the Forest and Rangeland Renewable Resources Planning Act of 1974.

1.06 Decision Framework

As the Responsible Official, the Forest Supervisor may decide to: (1) select the proposed action; (2) select one of the alternatives; (3) select one of the alternatives after modifying the alternative with additional mitigating measures or combination of activities from other alternatives; or, (4) select the no action alternative, choosing not to authorize the Rim Reforestation project. In making this decision, the Forest Supervisor will consider such questions as:

- How well does the selected alternative meet the purpose and need described in this EIS?
- How well does the selected alternative move the project area toward the desired conditions established in the Forest Plan?
- Does the selected alternative mitigate potential adverse effects?

Project-Level Pre-decisional Administrative Review (Objection) Process

This project is subject to comment pursuant to 36 CFR 218, Subparts A and B. Only those who submit timely project specific written comments[3] during a public comment period are eligible to file an objection. Individuals or representatives of an entity submitting comments must sign the comments or verify identity upon request. Comments received, including the names and addresses of those who comment, will be considered part of the public record on this proposal and will be available for public inspection.

1.07 Public Involvement

Public participation is important at numerous points during the analysis. The Forest Service seeks information, comments and assistance from federal, state and local agencies and individuals or organizations that may be interested in or affected by the proposed action.

Because of the scope and scale of this project public involvement was focused on from the very beginning. The Forest Service engaged two large collaborative groups. One local group, Yosemite Stanislaus Solutions (YSS) includes a wide variety of local county stakeholders including the timber industry, environmental organizations and business leaders. YSS fosters partnerships among private, nonprofit, state and federal entities with a common interest in the health and well-being of the landscape and communities in the Tuolumne River Watershed. The group fosters an all-lands strategy to create a heightened degree of environmental stewardship, local jobs, greater local economic stability, and healthy forests and communities. The other group, known as the Rim Fire Technical Team consists of representatives from state and national environmental organizations, the timber industry and other government entities with a more national or statewide interest base. The Forest Service met with both of these groups on several occasions including field trips into the burn area and all day workshops identifying the long-term goals of this landscape and future desired conditions.

The Forest Service held its first field trip into the Rim Fire on October 16, 2013 with individuals from the Tuolumne Band of Me-Wuk Indians, Central Sierra Environmental Resource Center (CSERC), Sierra Club, Tuolumne County Alliance for Resources and Environment (TuCARE), California Fish and Wildlife Service, Audubon Society, Tuolumne County Supervisors, logging companies, sawmills, Sierra Nevada Conservancy and the local collaborative group YSS. On November 14, 2013

[3] **Specific written comments**. Written comments are those submitted to the responsible official or designee during a designated opportunity for public participation (§ 218.5(a)) provided for a proposed project. Written comments can include submission of transcriptions or other notes from oral statements or presentation. For the purposes of this rule, specific written comments should be within the scope of the proposed action, have a direct relationship to the proposed action, and must include supporting reasons for the responsible official to consider.

the Rim Fire Technical Team toured the burn area with several stops and discussions with Forest Service managers and researchers. Several field trips and meetings followed focusing initially on the salvage.

The Rim Fire Technical Team held its first reforestation specific workshop on July 10, 2014 in Sacramento, California. This was followed by a two day workshop on August 18 and 19, 2014. Each of these workshops included presentations on reforestation by scientists from the Forest Service Pacific Southwest Research Station (PSW) and other experts followed by small group discussions and proposal development.

On December 16, 2014 a public pre-scoping meeting was held to discuss the initial proposed action developed by the Forest Service ID team. Members of YSS, the Rim Fire Technical Team and others attended (a total of 32 people).

Public Scoping Period (45 days) for the Notice of Intent

The Forest Service conducts scoping according to the CEQ regulations (40 CFR 1501.7). In addition to other public involvement, scoping initiates an early and open process for determining the scope of issues to be addressed in the EIS and for identifying the significant issues related to a proposed action. This scoping process allows the Forest Service not only to identify significant environmental issues deserving of study, but also to deemphasize insignificant issues, narrowing the scope of the EIS process accordingly (40 CFR 1500.4(g)).

The Forest Service first listed the Rim Reforestation project online [http://data.ecosystem-management.org/nepaweb/current-sopa.php?forest=110516] in the Stanislaus National Forest Schedule of Proposed Actions (SOPA) on October 7, 2014. The project first appeared in the published quarterly SOPA in January 2015. The Forest Service distributes the SOPA to about 160 parties and it is available on the internet [http://www.fs.fed.us/sopa/forest-level.php?110516].

The Forest Supervisor sent a scoping letter and package to 376 individuals, permittees, organizations, agencies, landowners, and Tribes interested in this project on February 27, 2015. The letter requested specific written comments on the Proposed Action during the initial 45-day designated opportunity for public participation. The Forest Service published a Notice of Intent (NOI) that asked for public comment on the proposal between February 27, 2015 and April 13, 2015 (80 Federal Register 39, February 27, 2015; p. 10663-10664). Interested parties submitted 63 total letters during the comment period. Other interested parties submitted 2 letters (late) after the comment period closed. The Scoping Summary (project record) identifies specific comments and shows how the ID team used them to identify issues (1.08 Issues).

The Forest Service organized field trips with the Tuolumne Band of Me-Wuk Indians on March 13, 2014 and March 17, 2014 followed by a Tribal consultation day on May 9, 2014.

Several public presentations of the scoping package were given to interested groups during the scoping period including the Tuolumne County Alliance for Resources and the Environment (TuCARE) Board of Directors, the local Sierra Club group and the Forest Range Permittees. A workshop was also held on April 8, 2015 and 17 people attended. Public open houses were also held on April 8 and April 10, 2015 where the Forest Service described the preliminary purpose and need for the project as well as proposed reforestation treatments. ID team members participated and answered questions regarding the project and proposed action. They were advertised on local radio stations, in the local newspaper, on the Stanislaus National Forest website, through direct mailings to those on the SOPA mailing list, and to those who showed interest in the project.

Ongoing Public Involvement

After the initial 45-day scoping period, the Forest Service continued scoping with interested parties. The Forest Service hosted another public workshop on July 8, 2015, to share the alternatives developed since the initial scoping, 17 interested individuals attended. The Forest Service continued field trips with interested groups and individuals including the Tuolumne Band of Me-Wuk Indians on July 15, 2015. The Forest Service also provided presentation to other interested groups including the Lions Club and TuCARE.

Public Comment Period (45 days) for the Draft EIS Notice of Availability

On November 20, 2015 the Forest Service published the Draft EIS (DEIS), maps and other project information on the internet [http://www.fs.usda.gov/project/?project=45612] and sent a letter announcing the DEIS via e-mail (181) or hard copy letter (25) to 206 interested individuals, permittees, organizations, agencies and Tribes including those who submitted unique comments during scoping. The letter requested specific written comments during the 45-day designated opportunity for public participation period that would begin with publication of the Notice of Availability (NOA) of the DEIS in the Federal Register (expected on November 27, 2015).

The 45-day comment period on the DEIS began with publication of the NOA in the Federal Register on November 27, 2015 (80 Federal Register 228, November 27, 2015; p. 74104). On December 1, 2015 the Forest Service published a legal notice in the Union Democrat announcing the Forest would accept comments for 45-days following the November 27, 2015 publication of the NOA in the Federal Register. During this period, the Forest hosted a public open house on December 3, 2015.

Interested parties submitted 34 comment letters (project record) on the DEIS including 1 that arrived after the comment period closed. The Response to Comments (Appendix F) identifies specific comments and the Forest Service responses to those comments. EIS Appendix L (project record) includes eight letters submitted by Federal, State, and Local Agencies (including elected officials and the Tuolumne Me-Wuk Tribal Council) as comments on the DEIS. The project record content analysis spreadsheet (Comment_Analysis.xlsx) contains all individual comments.

1.08 ISSUES

The Forest Service reviewed the purpose and need, proposed action and scoping comments in order to identify issues (Scoping Summary, project record). An issue is a point of discussion, dispute, or debate with the Proposed Action; an issue is an effect on a physical, biological, social, or economic resource; an issue is not an activity; instead, the predicted effects of the activity create the issue. The Forest Service separated the issues into two groups: significant and non-significant. The Council on Environmental Quality (CEQ) NEPA regulations explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)..."

Significant issues are defined as those directly or indirectly caused by implementing the proposed action. Significant Issues are used to formulate alternatives, prescribe mitigation measures, or analyze environmental effects. Issues are significant because of the extent of their geographic distribution, the duration of their effects, or the intensity of interest or resource conflicts.

Non-Significant Issues are those: 1) outside of the scope of the proposed action; 2) already determined through law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; 4) conjectural and not supported by scientific fact; 5) a comment, opinion, or statement of position; or, 6) a question for clarification or information. Although non-significant issues are not used to formulate alternatives or prescribe management requirements, the EIS will disclose all significant environmental effects including any related to non-significant issues. The Scoping Summary (project record) identifies non-significant issues and reasons why they were found non-significant.

Significant Issues

As described above, issues are significant because of the extent of their geographic distribution, the duration of their effects, or the intensity of interest or resource conflicts. Based on public comments, the Forest Service developed significant issues to formulate and compare alternatives, prescribe management requirements, or analyze and compare the environmental effects of each alternative. Table 1.08-1 displays significant issues with issue statements based on public comments submitted during scoping.

Table 1.08-1 Significant Issues

Issue/Element	Cause and Effect
1. Herbicides:	**The proposed herbicide applications may adversely affect human and other natural resources**.
1.1 Human Health	a. Toxins may contaminate the water supply, food chain and land, impacting residents and visitors through reproductive and developmental harm.
1.2 Native Species Health and Diversity	a. Herbicides may irretrievably alter natural post-fire successional habitat causing loss of significant biodiversity. b. Application of glyphosate formulations and other less understood herbicides may have negative direct, indirect and cumulative effects on aquatic species and terrestrial wildlife including: mortality; impaired growth and development; modified behavior; and, physiological or morphological effects.
2. Reforestation Method:	**The proposed reforestation methods may adversely affect human and other natural resources**.
2.1 Local Economy	a. Reforestation at low rates may take too long to reclaim control of the brush and competing vegetation. b. Future budgets may not provide adequate funding to control competing vegetation or thin trees. c. Low density planting may not provide a sustainable, long-term supply of wood needed to maintain the forest products infrastructure in Tuolumne County.
2.2 Native Species Health and Diversity	a. High density planting may limit fire use and foster unhealthy landscapes lacking biodiversity with reduced resiliency to drought, insects and wildfire. b. Low density planting may reduce wildlife hiding cover subjecting wildlife to increased vehicle related mortality, predation and poaching.
2.3 Forest Establishment	a. Wide and variable spacing and gaps between planted trees may complicate the planting process, favor competing vegetation and delay establishment of a new forest.
2.4 Fire Hazard	a. High density planting may result in fire-prone trees preventing early and frequent use of prescribed and natural fire. b. Wide and variable spacing and gaps between planted trees may result in areas with undesirable vegetation and increased fuel loadings.

1.09 GIS DATA

The Forest Service uses the most current and complete data available. Geographic Information System (GIS) data and product accuracy may vary. They may be developed from sources of differing accuracy, accurate only at certain scales, based on modeling or interpretation and/or, incomplete while being created or revised. Using GIS products for purposes other than those intended may yield inaccurate or misleading results. The Forest Service reserves the right to correct, update, modify, or replace GIS products without notification. The information contained within Chapter 2 (The Alternatives) of this EIS takes precedence in case of disagreement with the GIS data (including maps created using that data).

2. The Alternatives

This Chapter describes and compares the alternatives considered for the Rim Reforestation project. It presents the alternatives in comparative form, defining the differences between each alternative and providing a clear basis for choice among the options for the Responsible Official and the public. It includes the action alternative or the proposed action (Alternative 1), the no action alternative (Alternative 2), and three additional action alternatives (3, 4 and 5) that provide a comprehensive range for the decision maker. The no action alternative serves as a baseline for comparison purposes (73 Federal Register 143, July 24, 2008; p. 43084-43099). Based on the issues identified through public comment on the proposed action as well as the unique opportunities created by the Rim Fire, the Forest Service developed the other action alternatives that achieve the purpose and need through different combinations and types of activities than the proposed action. Some of the information used to compare the alternatives is based on the design of the alternative, and some of the information is based upon the environmental, social and economic effects of implementing each alternative.

This chapter is divided into five sections:

- Chapter 2.01 describes how the alternatives were developed.
- Chapter 2.02 presents the alternatives considered in detail.
- Chapter 2.03 describes the management requirements common to all action alternatives.
- Chapter 2.04 presents the alternatives considered, but eliminated from detailed study, including the rationale for eliminating them.
- Chapter 2.05 compares the alternatives based on their environmental, social and economic consequences including a comparative display of the projected effects of the alternatives.

Map Package

Detailed maps are available by request or online at: http://www.fs.usda.gov/project/?project=45612:

Map 1 - Desired Future Condition Alternatives 1, 3, 4 and 5
Plotter size (42 inch by 60 inch) map showing desired future conditions and fire emphasis areas.

Map 2 - Proposed Treatment Alternatives 1, 3 and 5
Plotter size (42 inch by 60 inch) map showing treatments (adaptive management; deer enhancement; natural regeneration; reforestation; and, thinning).

Map 3 - Proposed Treatment Alternative 4
Plotter size (42 inch by 60 inch) map showing treatments (adaptive management; deer enhancement; natural regeneration; reforestation; and, thinning).

Map 4 - Noxious Weed Treatment Alternatives 1 and 5
Plotter size (42 inch by 60 inch) map showing invasive plant sites identified for noxious weed eradication.

Map 5 - Noxious Weed Treatment Alternatives 3 and 4
Plotter size (42 inch by 60 inch) map showing invasive plant sites identified for noxious weed eradication.

2.01 How the Alternatives Were Developed

The project area includes NFS lands on the Stanislaus National Forest outside of Wilderness. It does not include any private, state or other federal lands. Each alternative assumes that other adjacent federal lands, such as those administered by Yosemite National Park will be managed according to existing management plans and applicable federal laws. Each alternative also assumes that private lands will meet applicable state and federal land use regulations.

Chapter 2.02 (Alternatives Considered in Detail) displays the alternatives fully considered in detail including four action alternatives and the no action alternative. Chapter 2.04 (Alternatives Considered but Eliminated from Detailed Study) describes other alternatives considered, but eliminated from detailed study. Appendix E (Treatments) provides detailed information related to the specific treatment units in each action alternative. Appendix N (Noxious Weed Schedule, project record) displays the implementation schedule for noxious weed eradication under each action alternative. Appendix R (Reforestation Schedule, project record) displays the implementation schedule for reforestation treatments under each action alternative. The map package includes large scale maps showing treatment units and other information included in each alternative.

Proposed Treatments with Adaptive Management

The Forest Service developed the action alternatives to represent a wide range of perspectives designed to address the purpose and need (1.03 Purpose and Need) and the issues identified through scoping (1.08 Issues). Next, they developed site-specific prescriptions focused on tree survival and the reintroduction of fire into planted areas while incorporating an adaptive management strategy for implementation. Adaptive management is a cycle of making a plan, applying appropriate land management tools with on-the-ground actions, monitoring results, and adjusting plans as necessary. Finally, the Responsible Official approved the range of alternatives described in this Chapter. The following activity groups apply to the action alternatives. The actions contained in each group were adjusted appropriately to achieve the desired results with the least adverse impacts. Not all activity groups or actions apply to every alternative, refer to the specific alternative descriptions.

Deer Habitat Enhancement

Favor oak species throughout all deer habitat enhancement units.

REFORESTATION IN DEER HABITAT

Site preparation, planting, release and prescribed burning treatments utilizing adaptive management as described under reforestation to promote successful reforestation and create future deer cover stands with an approach similar to the founder stand concept described under Alternative 4.

PLANT CONIFERS (DEER COVER STANDS)

Plant hiding cover in discrete stands up to 25 acres in size using a cluster planting design; alternate planting of 3-tree and 5-tree clusters. Space trees in the clusters 10 to 12 feet apart and space clusters no wider than 27 feet apart. These more open stand conditions allow for recruitment of understory vegetation, increasing the effectiveness of these areas as hiding cover.

Plant conifers for thermal cover in discrete stands up to 5 acres in size with trees spaced 10 to 14 feet apart. These areas are designed to provide dense canopy cover to protect deer from inclement weather. Strategically place both hiding and thermal cover discrete stands in close proximity to high quality foraging habitat (oak, grass and shrubs).

THIN FOR HIDING AND THERMAL COVER STRUCTURE WITHIN EXISTING PLANTATIONS IN DEER HABITAT

Create openings around established oaks or groups of oaks (live trees or saplings greater than or equal to six inches dbh) by removing conifers within 30 feet of the bole to allow oak to flourish, up to five oaks per acre.

Create hiding cover by clumping conifers with an average of 30 feet between clumps. Average four to seven conifers per clump with each acre having equal proportions of each clump size. Trees within the clumps should be 10 to 12 feet apart.

Create thermal cover by thinning individual conifer trees 17 to 23 feet apart.

Natural Regeneration

In areas with high potential for natural seeding from live green trees within and adjacent to the unit, monitor the area to determine if well dispersed natural regeneration has occurred. To achieve conditions similar to the Desired Future Condition identified for a specific location, seedling density, species composition and dispersal must be similar to that identified for planting under each alternative before considered naturally regenerated. If it does not meet these goals, implement the adaptive management strategy to plant additional trees. Reduce fuels on these sites where amounts exceed the fire and fuels management requirements (10 to 20 tons per acre depending on location). If natural regeneration is not adequate after five years, in regards to the species and number of trees across the landscape, then complete site preparation, planting and release treatments, as described under reforestation, to promote successful forest establishment. Release treatments may be used with natural regeneration if vegetation competition is prohibiting growth and impacting seedling survival.

Noxious Weed Eradication

Utilize an Integrated Pest Management (IPM) approach as the adaptive management strategy for weed eradication. Methods for removing noxious weeds include burning, targeted grazing, grubbing, herbicides and hand pulling.

On the Jawbone Lava Flat area, utilize prescribed fire to remove the thatch and other larger-sprouting vegetation. Follow burning with livestock grazing where feasible. Directly apply herbicide on the remaining noxious weeds. Monitor and use fire, targeted grazing or directed herbicide applications until the remaining noxious weeds are eliminated. Utilize hand pulling and grubbing on species and small populations that can be effectively treated in this manner (i.e. bull thistle in meadows).

Utilize hand pulling as the preferred method where it can effectively eradicate noxious weed populations. Where herbicides are required to meet this goal, use backpack sprayers for direct application to the targetted plants (spot spray) with EPA approved herbicides (glyphosate, clopyralid, aminopyralid and clethodim). The goal is to eradicate noxious weeds and invasive non-native pest plants and reduce spread within the Rim Fire area. Treatments would include yearly applications to prevent seed production and eventually eliminate the weed seed banks.

Identified noxious weeds include: bachelor button, barbed goatgrass, cut-leaf blackberry, Himalayan blackberry, black mustard/shortpod mustard, blessed milkthistle, bull thistle, Canada thistle, cheatgrass, Dyers woad, field bindweed, french broom, hedgeparsley, italian thistle, Johnsongrass, Klamathweed, medusahead grass, perennial sweetpea, puncturevine, scotch broom, spanish broom, spotted knapweed, tocalote, tumble mustard, woolly mullein and yellow star-thistle.

Reforestation

Reforestation uses adaptive management tools to reduce fuels, prepare the site for planting, plant conifers, release them from competition and re-introduce prescribed fire into the young plantations.

Site Preparation

Site preparation, may require a combination of the following methods: deep till followed by forest cultivation; feller buncher (remove biomass or pile and burn); hand cut, hand pile and burn or jackpot burn on steep slopes; machine pile and burn; manually apply herbicides; and, mastication (shred). All herbicide applications will be done by hand in a broadcast manner outside of sensitive areas and buffers.

Use site preparation when the amount of dead fuel on the site exceeds 10 or 20 tons per acre (depending on location) or when greater than 20% of the land is vegetated with grass or shrubs. Adaptive management starts with fuels reduction. Treat fuels with feller bunchers or dozers to machine pile and burn or masticate. On steep slopes hand cut, hand pile and burn or jackpot burn the woody fuels. Deep till and cultivate every acre for site preparation that is less than 30 or 35% slope, on the right soil type, and that is not fragmented by protected areas such as: sensitive plants, cultural resources or stream zones. Use chemical site preparation where competing vegetation cannot be effectively controlled or where deep tilling and cultivating would not be appropriate.

Plant conifers

Plant conifers after site preparation on acres with limited (less than prescribed in regards to the species and number of trees dispersed throughout the unit) or no natural regeneration.

Plant bare-root or container stock ponderosa pine, sugar pine, incense cedar, Douglas-fir, white fir and giant sequoia based on seed zones and elevation to meet the desired future condition (i.e., Open Canopy Mosaic and Old Forest Mosaic). Scalp a 1-foot square area to bare mineral soil prior to digging a hole for the seedling. Integrate existing conifers into the prescribed planting pattern, spacing off them the same distance as a planted seedling.

Planting will not occur in the following situations: natural regeneration areas, oak aggregates, riparian vegetation areas, selected openings, rock outcrops, along cliffs, cultural sites except where requested by the Tribe, or sensitive plant sites.

Release

Release improves survival of conifer seedlings by reducing competition for soil moisture, light and nutrients. The adaptive management trigger for release is when greater than 20 percent of the land is vegetated with grass or shrubs.

Manually grub vegetation by using hand tools such as modified hoes or loppers to sever all live vegetation below the root collar at ground level within 5 feet of each seedling. The severed vegetation, duff, and litter is removed down to bare mineral soil. Hand grubbing would need to occur twice a year (early and late spring) in order to remove the competing vegetation to an effective level. It is estimated that hand grubbing would be done twice a year for 5 years.

Use chemical release where competing vegetation cannot be effectively controlled with hoeing or grubbing (this includes areas with sprouting species such as bearclover and deerbrush). Glyphosate, along with the surfactants and colorants, Syl-tac™ and Colorfast™ Purple for chemical release may occur up to 3 times to ensure seedling survival and the established trees are free to grow among the grass, bearclover or other competing woody shrubs (i.e., when 20% or less of the land is vegetated with competing vegetation). All herbicide applications will be done by hand in a broadcast manner outside of sensitive areas and buffers.

Prescribed Fire

Utilize adaptive management to introduce prescribed fire into young plantations. The goal is to return fire back into the ecosystem within the first 10 years while sustaining the majority of the establishing trees. Due to the extent of the area, conditions advantageous to tree survivability will vary based on tree species, slope, environmental conditions, and fuel loading and will be evaluated through tree mortality modeling to determine the most opportune time and place for fire reintroduction.

Thin Existing Plantations

Thinning for Individuals, Clumps, and Openings (ICO) structure within existing plantations would require one of the following methods: feller buncher (remove biomass or pile and burn); hand cut, hand pile and burn; or mastication (shred). Prescribed fire (understory burning) would be done prior to the mechanical activities to reduce the existing fuels within these stands.

Thin individual conifer trees to 22 to 28 feet between boles (stems). The order of preference for leave trees is: sugar pine, Douglas-fir, incense cedar, white fir, and giant sequoia. Favor cutting ponderosa and Jeffery pines. All healthy sugar pine would remain on site per Regional direction regardless of spacing.

Clump the leave trees with an average of 30 feet between clumps or nearest single tree. Smaller clumps should average 8 conifers each and larger clumps should consist of 15 conifers. Leave an average of 6 small clumps and 2 large clumps per acre across the unit with more clumps near the drainages. Incorporate incense cedar, Douglas-fir, white fir and giant sequoia into clumps where feasible.

Create openings around established oaks or groups of oaks or other hardwoods (i.e. dogwood) by removing conifers within 30 feet of the bole to allow oaks to flourish and to create the open areas within the ICO structure. Thinning around 1 oak is about the same area as that of 1 conifer clump. No oaks would be cut, but a maximum of five oaks per acre would have the 30-foot clearance. Oaks should be clumped where possible.

Meadows: Remove all conifers less than 24 inches dbh, except healthy sugar pine without evident blister rust, within 25 feet of meadow edges. From 25 to 50 feet of the meadow edge, leave 4 clumps of 5 conifers, evenly dispersed around the meadow or space clumps 150 feet apart around larger meadows. Between 50 to 100 feet, leave 4 clumps of 10 conifers evenly dispersed around the meadow and off-set from those retained within the first ring or for larger meadows space clumps mid-point of the interior ring, about 150 feet apart. Figure 2.02-4 shows an example of how the meadow strategy would look on the landscape. Beyond the 100 feet, resume ICO prescription.

Streams: Along perennial and intermittent streams, remove conifers 20 feet from riparian obligate vegetation. Leave all sugar pine without evident blister rust.

Emergency Travel Routes: Remove conifers within 12 feet of an Emergency Travel Route except conifers 16 inches dbh and larger. Prune 10 feet up the bole of residual trees, including oaks.

Primary Ridges and Fuelbreaks: Within these features, thin conifers to a 30-foot spacing. Use the 30-foot buffer around all oaks. Where feasible, but no closer than one mile apart, incorporate helispots into thinning design by expanding upon existing openings. Minimum helispot size is 75 feet in diameter clear of all vegetation greater than 1-foot high.

Management Requirements

The action alternatives include management requirements designed to implement the Forest Plan and to minimize or avoid potential adverse impacts. Each action alternative lists the management requirements specific to it, while Chapter 2.03 identifies those common to all action alternatives. Management requirements are mandatory components of each alternative and will be implemented as part of the proposed activities. Most management requirements were utilized in other past projects and, through monitoring, were shown to be very effective in protecting or enhancing resources.

2.02 ALTERNATIVES CONSIDERED IN DETAIL

The action alternatives (Alternatives 1, 3, 4 and 5) and the no action alternative (Alternative 2) are considered in detail. The no action alternative, as required by the implementing regulations of NEPA, serves as a baseline for comparison among the alternatives (73 Federal Register 143, July 24, 2008; p. 43084-43099). The following sections describe each of the alternatives considered in detail. The map package and project record contain detailed maps of each action alternative.

Alternative 1 (Proposed Action)

This is the Proposed Action, as described in the Notice of Intent (80 Federal Register 39, February 27, 2015; p. 10663-10664), with corrections based on additional field surveys (i.e. new noxious weed populations discovered) and mapping refinement (1.04 Proposed Action). Alternative 1 includes the treatments and actions described below and shown on Map 1, Map 2 and Map 4 (map package). Chapter 2.01 provides more details about each treatment. Table 2.05-1 provides a summary of the proposed activities by alternative. Appendix E (Treatments) provides detailed information related to the specific treatment units in this alternative.

Deer Habitat Enhancement

Enhance deer habitat across 3,833 acres using reforestation, natural regeneration, thinning and prescribed fire. Within 2,636 acres plant conifers in 5 to 25-acre discrete deer cover stands (similar to Alternative 4 founder stands) on up to 646 acres (25% of the area) and treat the entire 2,636 acres with prescribed fire. An additional 33 acres will be monitored for Natural Regeneration and 1,164 acres thinned within the deer habitat enhancement. Table 2.02-1 shows the proposed treatment activities within these units.

Table 2.02-1 Alternative 1: Deer Habitat Enhancement Treatments

Alternative 1 (Proposed Action)	**Size** (acres)	**FB**	**MP**	**HC**	**HP**	**PF**	**HERB/SP**	**PLANT**	**HERB/REL**
Reforestation[1]	2,636	39	25			2,636	646	646	646
Natural Regeneration	33					33			
Thin	1,164	1,153		11	11	1,164			
Totals	**3,833**	**1,192**	**25**	**11**	**11**	**3,833**	**646**	**646**	**646**

FB=Feller Buncher; HC=Hand Cut; HERB=manual herbicide application; HP=Hand Pile; MP=Machine Pile (with dozer); PF=Prescribed Fire; SP=Site Preparation; REL=Release
[1] Similar to Alternative 4 founder stands, reforestation in deer habitat plants conifers on 646 (25%) acres of 2,636 unit acres.

Natural Regeneration

Alternative 1 includes natural regeneration on up to 4,031 acres. Reduce fuels if the amount exceeds the maximum (10 or 20 tons per acre) amount within the specific units. Monitor species and number of trees across the landscape to decide if site preparation, planting, release and burning would occur.

Noxious Weed Eradication

Alternative 1 includes noxious weed eradication on up to 5,714 acres. The majority of the noxious weed treatments are within the reforestation units. Appendix N (Noxious Weed Schedule, project record) displays the implementation schedule for noxious weed eradication under this alternative.

Reforestation

All acreages described under this section do not include reforestation acres proposed for deer habitat enhancement or natural regeneration. Appendix E (Treatments) provides detailed information related to the specific treatment units in this alternative. Appendix R (Reforestation Schedule, project record) displays the implementation schedule for reforestation treatments under this alternative.

SITE PREPARATION

Alternative 1 includes site preparation on up to 21,300 acres using a combination of the following methods (some units having more than one treatment applied, Appendix E): deep till followed by forest cultivation on 5,085 acres on less than 30 percent slopes; feller buncher (remove biomass or pile and burn, 3,139 acres); hand cut, hand pile and burn (74 acres) or jackpot burn on steep slopes (237 acres); machine pile and burn (912 acres); manually apply herbicides (16,215 acres); and mastication (shred, 1,844 acres). Site preparation activities are described below.

Deep Till and Forest Cultivate (subsoil): Deep till utilizing tractor drawn ripper shanks with subsoil wings to pass through the soil at a depth of as much as 30 inches along the contour slope. Tractors may pull 2 or 3 ripper shanks evenly spaced behind the tractor. This is followed by pulling a forest cultivator, with ripper shanks more frequently spaced on a V-shaped bar, to cultivate to an 18 inch depth. The cultivation treatment also occurs along the contour slope to prevent channeling of water in rainstorms. Deep tilling is designed to reduce soil compaction, improve planting quality, and reduce vegetation as forest cultivation is used to uproot competing vegetation species.

Feller Buncher: Use feller bunchers to cut trees. Mechanically remove material, as firewood, shavings logs, pulpwood, or chipped biomass fuel for electric cogeneration plants, or deck on site for public firewood cutting. If these options prove infeasible, then bunch material into piles and burn. Within existing plantations, remove both dead and live conifers to reduce live conifer density and promote desired ICO structure, favoring the healthiest conifers and the most diverse mix of tree species.

Hand Cut, Hand Pile and Burn: Hand cut trees that cannot be treated mechanically for various reasons such as slope conditions and resource concerns. Remove both dead and live conifers to reduce live conifer density and promote desired ICO structure in existing plantations, favoring the healthiest conifers and the most diverse mix of tree species. In new reforestation units, cut only dead trees and pile for burning.

Machine Pile and Burn: Push brush, small trees and downed fuels into piles for burning. This treatment may sometimes include hand felling larger dead trees. Use this method in areas with high down fuel loads and areas with standing dead trees that would inhibit access and worker safety and result in high tree or seedling mortality if burned.

Manually Apply Herbicides (Glyphosate): Use backpack sprayers for application of Glyphosate (plus a surfactant and colorant) to initially set back competing vegetation.

Mastication (shred): Mastication treatments consist of a tractor, excavator or loader with a cutting head used to shred brush, small trees, and large downed woody debris. Shredded material remains on site. Cut both dead and live conifers as necessary to reduce live conifer density and promote desired ICO structure, favoring the healthiest conifers and diverse mix of tree species. Both live and dead brush would be treated.

Prescribed Fire (Understory Burning and Jackpot Burning): Understory burns (using low intensity fire) in areas where fuel needs to be removed prior to planting or where natural regeneration is left free to grow. Jackpot burn (consume fuel concentrations) where feasible, but entire units may be treated to remove excess fuels and/or vegetation prior to planting. This is also proposed in existing plantations prior to thinning.

PLANT CONIFERS

Alternative 1 includes planting conifers on up to 21,300 acres. Base composition and density on landscape position, Strategic Fire Management Areas (SFMA) and elevation. Table 2.02-2 describes the planting design by landscape position.

Table 2.02-2 Alternative 1: Planting Design by Landscape Position

Landscape Position	Planting Design Within SFMA	Planting Design Outside SFMA	Size (acres)	Percent of Area
Emergency Travel Routes	12 to 16-foot spaced 20-tree pyramid (no top, Figure 2.02-1. A no-conifer zone is within 12 feet of the road. The next zone has pyramid shaped clusters of 20 conifers out to 68 feet from the road. (152 trees per acre).	Same as within SFMA	866	4
Fuelbreak	30-foot no plant strip centered in the middle with 150 feet on each side planted with 13 to 17-foot spaced conifers (176 trees per acre) creating a 330 foot wide strip.	Same as within SFMA	642	3
Primary Ridge	Same as Fuelbreak design. 183 acres.	13 to 17-foot spaced conifers in a 250-foot wide strip (194 trees per acre). 308 acres.	491	2
Mid-slope Open Canopy Mosaic	Macro-clusters, 25 trees per cluster. Plant individual trees on a 10 to 14 foot spacing, plant 5 rows and skip 1 row in both directions (210 trees per acre, Figure 2.02-1). 4,259 acres.	4-Tree micro-clusters, as shown in Figure 2.02-1, with 14 feet between outside trees, 7 feet to the middle tree and 26 feet between cluster centers. Closest tree to tree is 12 feet and farthest tree to tree is 27 feet (257 trees per acre, Figure 2.02-1). 4,691 acres.	8,951	43
Mid-slope Old Forest Mosaic	Macro clusters, 100 trees per cluster. Plant individual trees on a 10 to 14-foot spacing, plant 10 rows and skip 1 row in both directions (250 trees per acre). 903 acres.	Plant individual trees using a 10 to 14-foot spacing (303 trees per acre, Figure 2.02-1). 5,587 acres.	6,491	30
Drainages	Plant individual trees using a 10 to 14-foot spacing in a 300-foot wide planting area (303 trees per acre). Where a road crosses a drainage, the Emergency Travel Routes prescription takes precedence.	Same as within SFMA	3,859	18
		Totals	**21,300**	**100**

SFMA=Strategic Fire Management Areas. Numbers may not total due to rounding errors.

Oak Buffers: Offset conifer planting 25 feet from the bole of remnant oaks (defined as 8 feet tall and 0.5 inches dbh) or regenerating oak aggregates regardless of topographic position at up to 5 oaks per acre. Within 20 feet of oaks, do not apply herbicides for reforestation unless needed to control invasive species.

Meadows: A no-tree zone is within 25 feet of meadows. Plant 4 clumps of 5 conifers, evenly dispersed in a 25 to 50-foot zone from the meadow edge, or space clumps 150 feet apart around larger meadows. In the next 50 to 100-foot zone, plant 4 clumps of 10 conifers evenly dispersed and off-set from those retained within the first zone, or for larger meadows space clumps mid-point of the interior zone, about 150 feet apart. Beyond the 100 feet, resume prescription.

Figure 2.02-1 and Figure 2.02-2 illustrate how initial planting would look for some of the various landscape positions described above. Figure 2.02-1 includes the maximum number of seedlings that would be planted with five oaks per acre buffered by 25 feet; it does not show other non-planting areas such as rock outcrops or sensitive plant sites which would be encountered in most areas. Figure 2.02-2 uses the exact pattern as Figure 2.02-1, but randomly removed 25% of the trees to represent the maximum amount of surviving seedlings expected five years after site preparation and release treatments. In areas where only mechanical and hand treatments are proposed (Alternative 3) the mortality is expected to be 30 to 50%.

Figure 2.02-1 shows an example of planting individual trees using a 10 to 14-foot spacing (mid-slope old forest mosaic outside of SFMA), Emergency Travel Routes, and both mid-slope open canopy mosaic prescriptions in and outside of SFMAs. Oaks with buffers are interspersed with conifers.

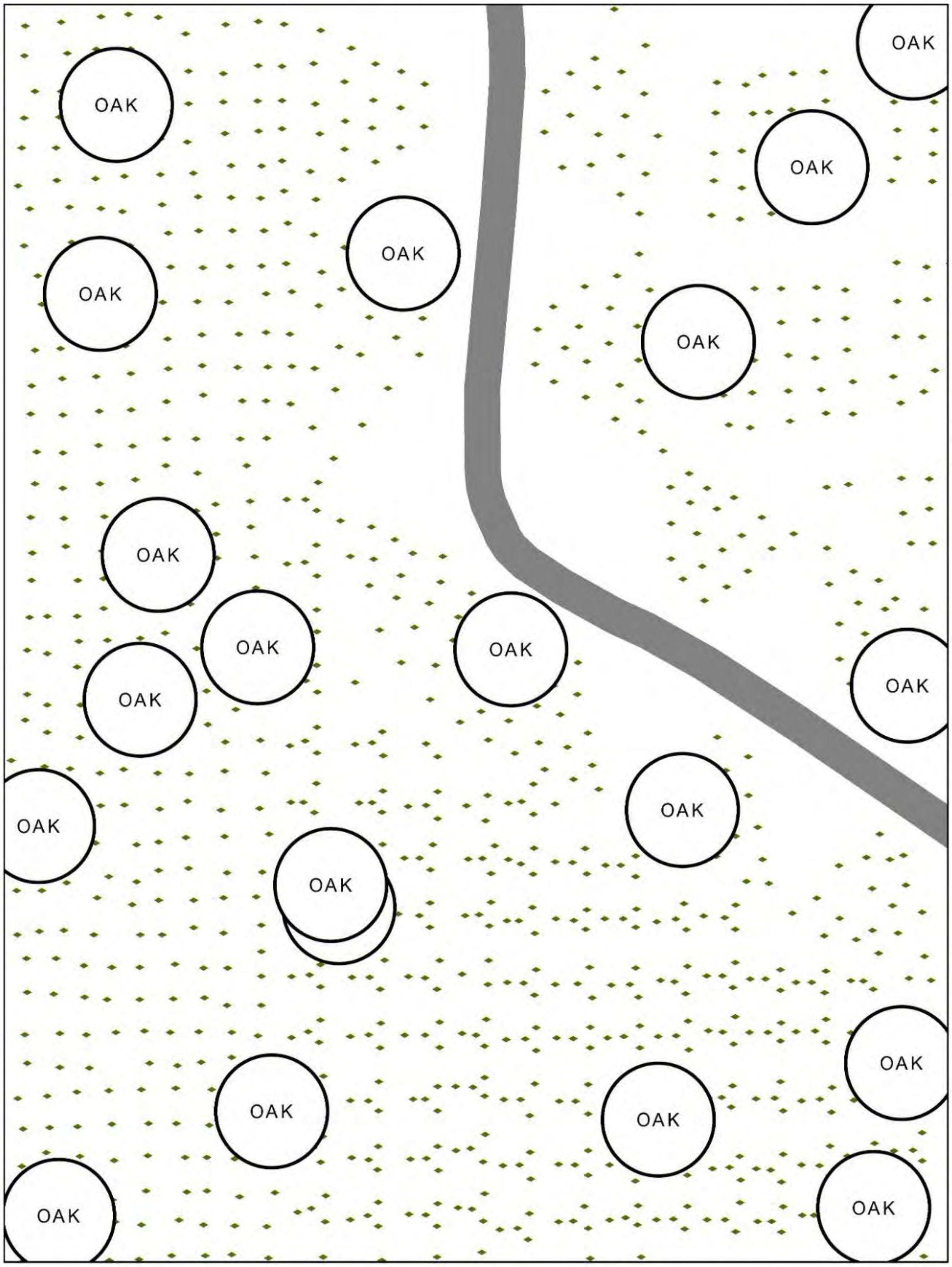

Figure 2.02-1 Alternative 1 Planting Prescriptions

Figure 2.02-2 shows 25% expected mortality in areas treated with DTFC and herbicides. Approximately 50% mortality is expected in areas that only have mechanical and/or hand treatments.

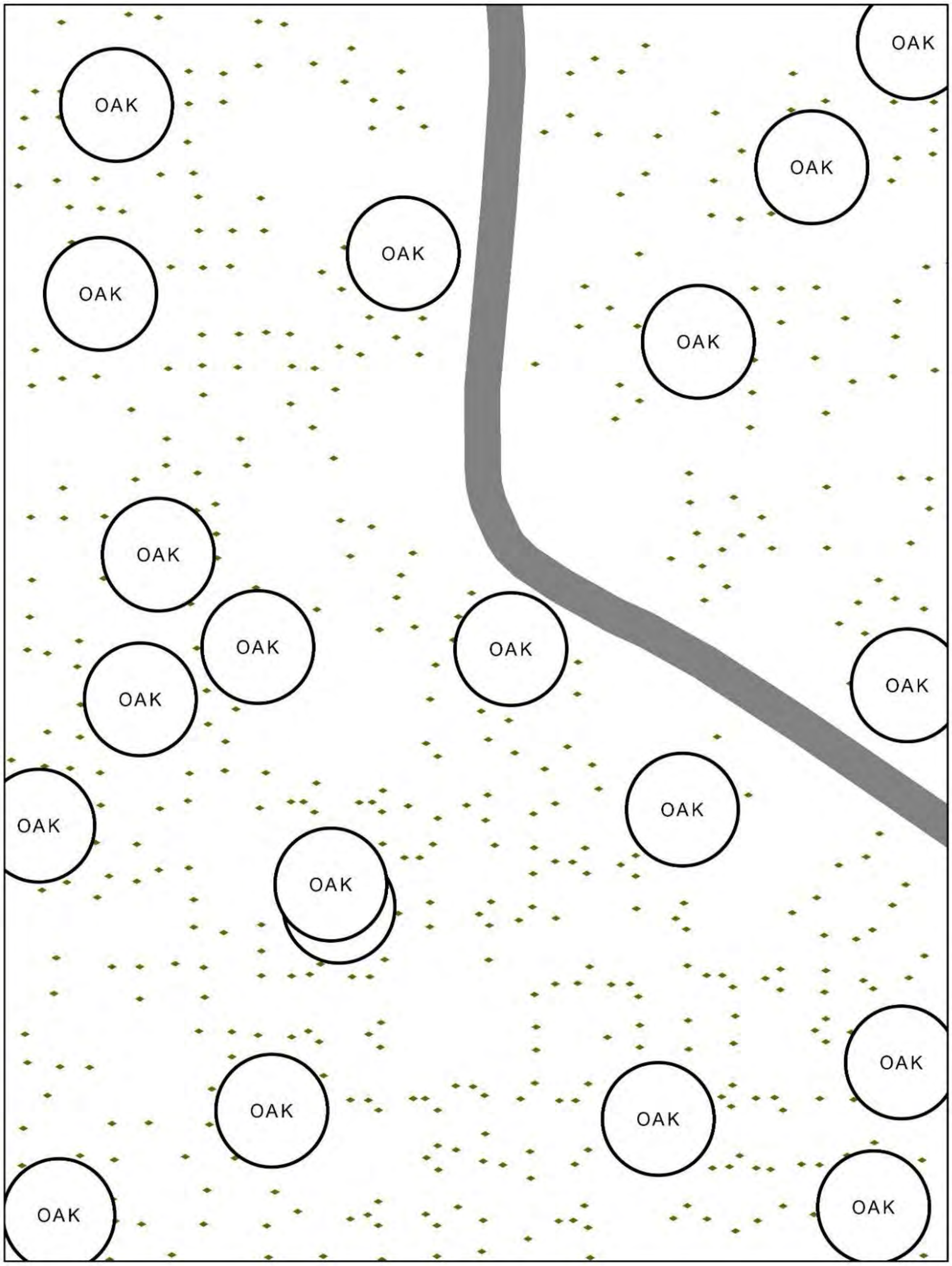

Figure 2.02-2 Alternative 1 Planting Prescriptions with 25% Expected Mortality

Figure 2.02-3 shows the reforestation landscape strategy for fuelbreaks and primary ridgelines, mid-slopes, Emergency Travel Routes and drainages.

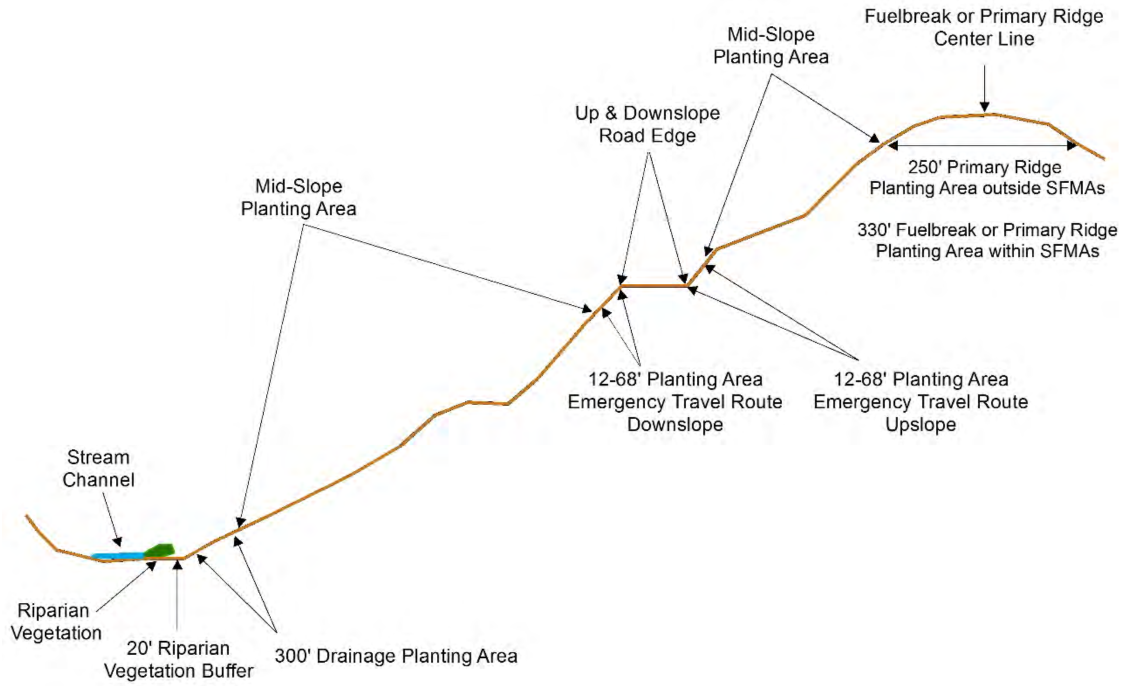

Figure 2.02-3 Reforestation landscape strategy

Figure 2.02-4 shows an example of how the meadow strategy would look on the landscape.

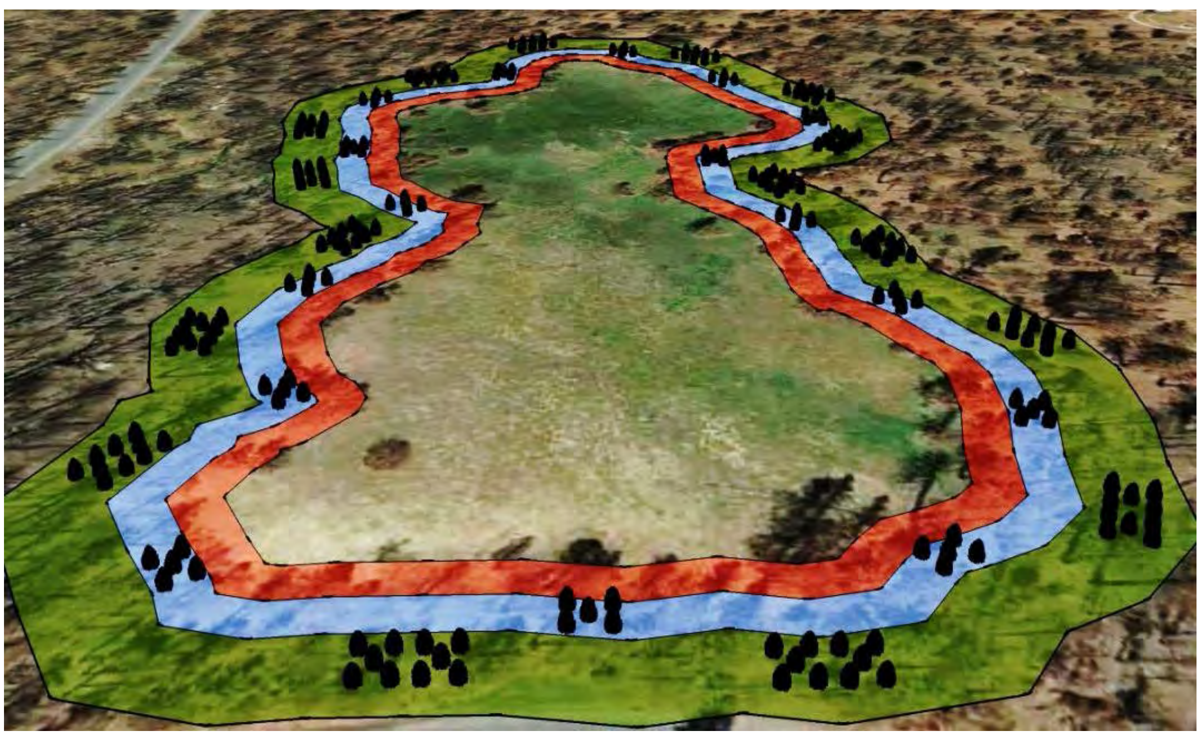

Figure 2.02-4 Meadow prescription strategy

Table 2.02-3 shows the number of conifer trees planted per acre in various landscape positions. It also shows the trees per acre (TPA) planted as influenced by existing oak trees and the expected survival after 5 years.

Table 2.02-3 Alternative 1: Trees Per Acre with 5 Oaks and 25% Expected Mortality after 5 Years

Landscape Position	TPA Outside SFMA	TPA With 5 Oaks Per Acre	TPA With 25% Mortality
Emergency Travel Routes	152	117	88
Fuelbreak	176	136	102
Primary Ridge	194	150	112
Mid-Slope Open Canopy Mosaic	257	199	149
Mid-Slope Old Forest Mosaic	303	235	176
Drainages	303	235	176

RELEASE

Alternative 1 includes hand grubbing or manually applying herbicides (glyphosate) on up to 21,300 acres.

PRESCRIBED FIRE

Alternative 1 includes prescribed fire in new plantations on up to 21,300 acres.

Thin Existing Plantations

Alternative 1 includes prescribed understory burning and thinning within existing plantations (outside of Deer Habitat Enhancement) on up to 12,769 acres. Deer Habitat Enhancement areas are also proposed for ICO thinning, but have their own specific prescription.

Management Requirements

Alternative 1 includes the following management requirements in addition to those in 2.03 Management Requirements Common to All Action Alternatives.

AQUATIC SPECIES

1. Herbicide Operations:
   a. Do not refill individual herbicide backpacks within 50 feet of any stream with surface water.
   b. Do not use stream water for mixing herbicides or for rinsing equipment or containers that have contained herbicide mix.
   c. Do not apply herbicide formulations within 50 feet of Eleanor Creek or the two ponds on Kibbie Ridge.
   d. Between June 1 and September 1, avoid herbicide applications within 100 feet of habitats known to be occupied by Western Pond Turtle (WPT).
   e. Do not apply herbicide formulations within 25 feet of streams with known occurrences of foothill yellow-legged frogs unless approved by an aquatic biologist.
   f. Do not apply herbicide within 107 feet of suitable habitat of Sierra Nevada yellow-legged frogs unless reviewed by an aquatic biologist.
   g. Restrict herbicide type in both upland and near-aquatic suitable habitat for California red-legged frog; permitted herbicides include aminopyralid and glyphosate (aquatic formulation) only.

CULTURAL RESOURCES

2. Flag and avoid all eligible and unevaluated cultural resources during implementation except for the following activities which are allowed under the Rim Programmatic Agreement (PA):
   a. Herbicide application within historic sites such as railroad logging camps, logging activity areas, railroad grades, historic trails/roads and ditches is permitted.

   b. Spot apply noxious weed treatments within prehistoric site boundaries, as long as the herbicide does not affect the use of resources by Native Americans.
3. Place signage, indicating application date and herbicide name, on-site once herbicide treatments begin and leave on-site for 30 days after application ends. Additionally, place a map at the Tuolumne Rancheria Tribal Hall indicating where and when areas were sprayed.

RANGE

4. Notify a range specialist at least 8 weeks in advance of application if withholding of grazing is recommended by herbicide product label.

SOILS

5. Deep Tilling and Forest Cultivation:
   a. On slopes over 20%, maintain at least one 8 to 10-foot vegetated buffer strip for every 100 feet of contour deep tilling or forest cultivation; this area can overlap with the unplanted rows or areas in planting design. In units with only portions identified that are suitable for deep tilling, consult with a soil scientist to assist in delineating these areas on the ground before the work begins.
   b. For deep tilling units with slopes greater than 15%, leave a buffer strip of 12 feet on the downhill side of roads that may concentrate water and drain onto a deep tilled unit.
   c. Deep till followed by forest cultivation on less than 30% slopes.

TERRESTRIAL WILDLIFE

6. Prohibit herbicide application within 100 feet of elderberry plants.

VEGETATION

7. Protect all madrones during herbicide applications. Prohibit herbicide application within 20 feet of madrone trees, saplings and seedlings except where needed for noxious weed eradication.

8. Herbicide Operations:
   a. Inspect sites prior to herbicide application to ensure that no one is present who is not officially participating in the application process.
   b. Post signs after application, identifying the date and chemical used, adjacent to units at common entry points. Posted information includes the type of herbicide applied, date of treatment and a contact name and phone number.
   c. Restrict access into the treated areas until the liquid herbicide solution has dried.
   d. Follow all label requirements for personal protective equipment (PPE).
   e. Use minimum protective clothing, unless specified otherwise on the label. This includes: coveralls over shirt and pants, socks, boots, safety glasses or goggles, hardhats and chemical resistant gloves. All clothing will be clean at the start of the day. Change clothing and clean the skin with soap and water if the herbicide mixture penetrates the clothing.
   f. Provide soap and clean water at the work site. Wash with soap and water immediately after contact with the herbicide mixture. Wash with soap and water before eating, smoking or going to the bathroom.
   g. To reduce off-site movement, drift, or volatilization, do not apply when the following weather parameters are observed:
      - Sustained winds in excess of 5 mph.
      - Precipitation, or a 70% or greater chance, predicted within 24 hours.
      - Foggy weather
      - Excess dew on target plants
      - Less than 30% relative humidity
      - Temperature that exceeds 85 degrees Fahrenheit
      - Temperature inversions that could lead to off-site movement of the herbicide mixture

WATERSHED

9. Management Requirements Incorporating BMPs and Forest Plan S&Gs: Table 2.02-4 presents management requirements pertaining to vegetation manipulation by herbicide application.

Table 2.02-4 Alternative 1: Management requirements incorporating BMPs and Forest Plan S&Gs

Management Requirements	BMPs/Forest Plan[1]/Locations
Vegetation Manipulation/Herbicide Use - Comply with all label and other applicable legal requirements for herbicide use and cleaning and disposal of pesticide equipment and containers. Incorporate a spill contingency plan into the project safety plan and have on site during herbicide application. - To protect streams and special aquatic features, do not apply Glyphosate within the following designated buffers zones: 10 feet from the edge of perennial, intermittent or ephemeral streams; special aquatic features such as springs, seeps and fens; and, obligate riparian vegetation. The 10-foot buffer does not apply if any intermittent stream or ephemeral stream is dry at the time of application. - Do not apply Clopyralid, Aminopyralid and Clethodim within the following designated buffer zones: 50 feet from the edge of perennial, intermittent or ephemeral stream; special aquatic features; and wet areas with standing water at the time of application; 10 feet from the edge of obligate riparian vegetation; 15 feet from the edge of any intermittent or ephemeral stream, or special aquatic features dry at the time of application. - Do not apply Clopyralid, Aminopyralid and Clethodim to areas with high surface runoff potential such as road surfaces, roadside ditches, shallow soils, and rocky or compacted slopes adjacent to perennial or intermittent streams. To avoid excessive leaching, soils should not be saturated at time of application. Soil moisture should be drier than field capacity. - Storage of Herbicides: No storage of herbicides will be allowed on RCAs other than what will be carried in the contractor(s) vehicle to complete each day's work. Mixing and loading will be done in areas where accidental spills will not contaminate streams or other water. Mixing sites will be predetermined by the COR and should be as far from water and on ground as level as possible. Include spill cleanup procedures in all project plans.	**Regional BMPs** 5-7 Pesticide Use Planning Process 5-8 Pesticide Application According to Label Directions and Applicable Legal Requirements 5-11 Cleaning and Disposal of Pesticide Containers and Equipment 5-12 Streamside Wet Area Protection During Pesticide Spraying **National Core BMPs** Chem-1 Chemical Use Planning Chem-2 Follow Label Directions Chem-3 Chemical Use Near Waterbodies Chem-5 Chemical Handling and Disposal **Forest Plan S&Gs** 193 (RCO 1) **Locations**: all units with applications in RCAs.

[1] Forest Plan S&Gs indicate page number from Forest Plan Direction (USDA 2010a).

Alternative 2 (No Action)

Alternative 2 (No Action) provides a baseline for comparison with the other alternatives (Table 2.05-1). Under Alternative 2 (No Action), deer habitat enhancement, noxious weed eradication, reforestation (site preparation, planting conifers, release and reintroduction of prescribed fire) and thinning would not occur. Current management plans would continue to guide management of the project area.

Alternative 3

Alternative 3 responds to the significant issues and concerns identified through public scoping (1.08 Issues). Compared to Alternative 1, it addresses those issues by proposing: additional human and native species health protections (no herbicides) and a different fuelbreak ridge treatment responding to the reforestation issue of fire hazard. Because no herbicides would be used for site preparation, release or noxious weed eradication, additional deep tilling and forest cultivation and manual grubbing treatments were added. Alternative 3 includes the treatments and actions described below and shown on Map 1, Map 2 and Map 5 (map package). Chapter 2.01 provides more details about each treatment. Table 2.05-1 provides a summary of the proposed activities by alternative. Appendix E (Treatments) provides detailed information related to the specific treatment units in this alternative.

Deer Habitat Enhancement

Alternative 3 includes similar deer habitat enhancement treatments as Alternative 1 within the same 3,833 unit acres; however, site preparation includes 646 acres of tilling and hand grub release to replace herbicide use on the 646 planted acres.

Natural Regeneration

Alternative 3 includes the same natural regeneration units as Alternative 1 on 4,031 acres that could potentially be planted. Treatments would be similar to Alternative 1, except mechanical site preparation and hand grubbing for release would replace herbicide use.

Noxious Weed Eradication

Alternative 3 proposes noxious weed eradication on approximately one half of the acres as Alternative 1. Only those populations and species that can be effectively eliminated through non-chemical means are proposed for treatments on 3,131 acres. Methods for removal include: burning, targeted grazing, grubbing, hand-pulling, and native seeding. The majority of the noxious weed treatments are within the reforestation units. Appendix N (Noxious Weed Schedule, project record) displays the implementation schedule for noxious weed eradication under this alternative.

Reforestation

All acreages described under this section do not include reforestation acres proposed for deer habitat enhancement or natural regeneration. Alternative 3 would reforest the same 21,300 acres as Alternative 1. Appendix E (Treatments) provides detailed information related to the specific treatment units in this alternative. Appendix R (Reforestation Schedule, project record) displays the implementation schedule for reforestation treatments under this alternative.

SITE PREPARATION

Alternative 3 includes site preparation on up to 13,175 acres using a combination of the following methods: deep till followed by forest cultivation (8,893 acres); feller buncher (remove biomass or pile and burn, 3,139 acres); hand cut, hand pile and burn (74 acres) or jackpot burn on steep slopes (237 acres); machine pile and burn (912 acres); and mastication (shred, 1,844 acres).

Alternative 3 deep tills and forest cultivates an additional 3,808 acres over Alternative 1 for a total of 8,893 acres within the proposed conifer planting areas. Alternative 3 includes deep tilling and forest cultivation treatment on slopes up to 35% (increased from 30% in Alternative 1) and drops the two tilling-related management requirements for untreated buffer strips.

Alternative 3 site preparation methods for the removal of competing vegetation just includes deep till and forest cultivation. Because Alternative 3 does not include the application of herbicides for the removal of competing vegetation, no site preparation for competing vegetation would occur on 12,407 acres. In these areas, hand grubbing of the competing vegetation would be necessary immediately following tree planting to help initial survival of the seedlings.

PLANT CONIFERS

Plant conifers on 21,300 acres using a variable planting design (Table 2.02-5). Because of the higher expected mortality levels, space individual trees 10 to 14 feet apart and within clumps space trees 6 to 8 feet apart to help ensure over 200 trees per acre survive after 5 years (Table 2.02-5). The desired variable densities reflect slope position and fuels emphasis areas as stated in Alternative 1. Oak buffers and meadows are the same as Alternative 1.

Table 2.02-5 Alternative 3: Variable tree planting strategy

Planting Strategy	Spacing (feet)	Trees (per clump)	Clumps (per acre)	Trees (per acre)
Individuals	10 to 14	NA	NA	194 to 364
Small Clumps	6 to 8	5	4 to 6	20 to 30
Medium Clumps	6 to 8	15	2 to 6	30 to 90
Large Clumps	6 to 8	30	0 to 1	0 to 30
Totals	**NA**	**NA**	**6 to 13**	**244 to 514**

Strategic Fire Management Areas: In Alternative 3, within reforestation units, the identified Strategic Fire Management Feature (SFMF) fuelbreaks are approximately 90 feet across and are bordered by 80 feet of 15-foot by 15-foot planting on each side for a total width of 250 feet (486 acres). Within the center of these fuelbreaks, plant one row of 4-tree micro-clusters (14 feet between outside trees, 7 feet to the middle tree and 26 feet between cluster centers) leaving about 32 feet of a no-plant area on each side before beginning the 15-foot by 15-foot spaced planting pattern. The 90 foot fuelbreak center has 74 trees per acre and the adjacent 80 foot areas have 194 trees per acre, averaging 151 trees per acre. Where roads are present within the center of the fuelbreak, alternate the planting of 4-tree micro-clusters on each side of the road beginning 12 feet off of the road edge. Primary ridges that do not include fuelbreaks are the same as Alternative 1 outside of SFMAs. Emergency Travel Routes are the same as Alternative 1.

On fuelbreaks and along Emergency Travel Routes, separate continuous vegetation between one and 12 feet tall, into naturally appearing clumps to break up horizontal fuels across the fuelbreak on an approximate five year maintenance interval. Remove fire ladders into the developing overstory. Dispose of slash by piling, burning, chipping, masticating or removing.

Table 2.02-6 shows the number of conifer trees planted per acre in various landscape positions. It also shows the trees per acre planted as influenced by existing oak trees and the expected survival after 5 years.

Table 2.02-6 Alternative 3: Expected trees per acre with 5 oaks and 50% mortality after 5 years

Landscape Position	TPA outside SFMA	TPA with 5 Oaks per Acre	TPA with 50% Mortality
Emergency Travel Routes	152	117	59
Fuelbreak	151	117	59
Primary Ridge	194	150	75
Minimum variable strategy	244	189	95
Maximum variable strategy	514	398	199

RELEASE

Release would be accomplished by manually grubbing vegetation on 21,300 acres. Depending on the competing species, this would require more than one grub per year and several consecutive years of treatment to ensure seedling survival. Grass and sprouting species, such as bearclover, can only be effectively set back with more than one treatment a year. This project analyzes for an early spring grub (when vegetation first begins to sprout and grow) and a late spring grub to eliminate the subsequent sprouting and seeding species. No herbicides would be used.

PRESCRIBED FIRE

Alternative 3 includes similar burning through new plantations post-planting as Alternative 1 on the same 21,302 acres.

Thin Existing Plantations

Alternative 3 includes similar understory burning and thinning on 12,769 acres in existing plantations as Alternative 1.

Management Requirements

Alternative 3 includes the following management requirements in addition to those in 2.03 Management Requirements Common to All Action Alternatives.

SENSITIVE PLANTS

1. Do not deep till and forest cultivate in units BB069, BB071 and BB072. Provide a 500-foot buffer for *Botrychium* species and *Eryngium* sp. nov. Provide a 200-foot buffer for *Cypripedium montanum, Mimulus filicaulis* and *Mimulus pulchellus* occurrences.

SOILS

2. Deep till followed by forest cultivation on less than 35% slopes.

Alternative 4

Alternative 4 responds to the significant issues and concerns identified through public scoping (1.08 Issues). Compared to Alternative 1, it addresses those issues by proposing: considerably fewer planted acres and trees and the reintroduction of early and frequent use of prescribed and natural fire within and adjacent to these stands. Thousands of acres, proposed in Alternative 1, would not have initial mechanical fuels treatments and would remain unplanted in Alternative 4. Reforestation would occur on 2,867 acres. In addition, complex early seral forest is left intact and removed from reforestation consideration.

Complex early seral forest follows stand-replacing disturbance in a mature forest and is characterized by abundant snags and downed logs, natural conifer regeneration, and development of a diverse understory community of post-disturbance vegetation and associated wildlife (DellaSala et al. 2014).

Complex early seral forest (19,971 acres) is allowed to develop unassisted except for the use of prescribed fire. Allow plants and tree seedlings to naturally regenerate and reoccupy the site among the dead over-story trees in a pattern determined only by processes and conditions unaltered by human intervention except for prescribed fire. Alternative 4 includes the treatments and actions described below and shown on Map 1, Map 3 and Map 5 (map package). Chapter 2.01 provides more details about each treatment. Table 2.05-1 provides a summary of the proposed activities by alternative Appendix E (Treatments) provides detailed information related to the specific treatment units in this alternative.

Deer Habitat Enhancement

The area of deer habitat enhancement (3,833 acres) in Alternative 4 has the same acres of prescribed burning and ICO thinning as Alternative 1 (1,164 acres). This alternative also includes 88 acres of planting, 558 acres fewer than Alternative 1.

Natural Regeneration

Alternative 4 does not include natural regeneration treatments as described in Alternative 1. Alternative 4 addresses natural regeneration through Reforestation and Plant Conifers (Founder Stands) described below.

Noxious Weed Eradication

Alternative 4 includes similar noxious weed eradication as Alternative 3 on 3,331 acres. No herbicides would be used. Appendix N (Noxious Weed Schedule, project record) displays the implementation schedule for noxious weed eradication under this alternative.

Reforestation

Alternative 4 would reforest no more than 20% of each unit proposed in Alternative 1, 2,867 acres. Appendix E (Treatments) provides detailed information related to the specific treatment units in this alternative. Appendix R (Reforestation Schedule, project record) displays the implementation schedule for reforestation treatments under this alternative.

SITE PREPARATION

Alternative 4 includes similar manual site preparation treatments as described in Alternative 1, but only on 20% of each unit (2,867 acres). This includes the use of herbicides in order to intensely manage (for brush abatement and tree survival) these small areas across the landscape. Deep tilling and forest cultivating is not proposed due to the small size of the areas proposed for treatment (less than 10 acres).

PLANT CONIFERS (FOUNDER STANDS)

Outside of complex early seral forest, plant founder stands within the same units identified in Alternative 1. Founder stands are small variable-shaped planted areas ranging from 2 to 10 acres in size within a larger area. Plant up to 20% of a contiguous seedling-deficient polygon and leave the remainder unplanted. Plant 20 to 40 clusters per acre spaced an average of 33 feet apart, variably spaced based on site conditions. Within each cluster, plant 5 trees spaced 6 feet between each tree. This provides 100 to 200 trees per acre on a given planted acre.

All reforestation activities should be a minimum of 200 feet away from known sensitive plant populations. Do not plant within the designated fuelbreaks (based on the Alternative 1 design), Emergency Travel Route corridors, along primary ridges, drainage bottoms, or in the thin and reforest units (surviving older plantations). Focus planting areas within the mid-slope of each unit where natural regeneration is less likely to occur.

Plant bare-root or container stock ponderosa pine, sugar pine, incense cedar, Douglas-fir, white fir and giant sequoia based on seed zones and elevation. Scalp a 1-foot square area to bare mineral soil prior to digging a hole for the seedling. Plant trees in distinct groupings that allow for fire use in and adjacent to planted areas within a decade of being planted. Utilize or culture existing living trees as anchors for future regeneration. Prioritize planting in selected areas that have higher amounts of shading, cooling or extended water retention to enhance tree survival. Vary planting density by site condition and topographic position, e.g., higher density within the range for high site conditions or lower on a slope. Table 2.02-7 shows the number of conifer trees planted per acre in founder stands along with the expected survival after 5 years.

Table 2.02-7 Alternative 4: Expected trees per acre with 5 oaks and 25% mortality after 5 years

Founder Stand Strategy	TPA of Seedlings Planted	TPA with 5 Oaks/Acre[1]	TPA with 25% Mortality
Minimum Founder Stand Strategy	100	0	75
Maximum Founder Stand Strategy	200	0	150

[1] Oak buffers should not affect the number of seedlings planted per acre because of the wide spacing between planted clumps.

RELEASE

Alternative 4 includes manually applying herbicides (glyphosate) on up to 4,012 acres to initially ensure limited vegetation competition to the planted seedlings and to maintain a buffer of 25 feet to 50 feet around Founder Stands. Manage the buffer to maintain a lower brush component to reduce fire spread and increase fire resilience within the planted areas.

PRESCRIBED FIRE

Alternative 4 treats 50% of the reforested areas (7,186 acres) and 50% (9,986 acres) of the complex early seral forest with prescribed fire within one fire return interval (approximately 10 years). Use a dozer to line the plantations prior to burning, where needed. Prescribed fire would be returned to the other 50% of the areas (17,172 acres) in the second decade and then repeated through time. The emphasis is on returning fire to this landscape.

Thin Existing Plantations

Alternative 4 includes similar understory burning and thinning on 12,769 acres in existing plantations as Alternative 1.

Management Requirements

Alternative 4 includes the same management requirements as Alternative 1 (including those in 2.03 Management Requirements Common to All Action Alternatives) along with the following additional Fire and Fuels requirements.

FIRE AND FUELS

1. Outside of strategic areas identified specifically to provide for firefighter safety as part of a landscape-wide and long-term prescribed fire program, no standing dead trees shall be felled or downed wood shall be piled and burned or otherwise removed from areas that meet the desired conditions for complex early seral forest or are important to sustain wildlife.
2. Manage snags and other fuels in strategic areas identified specifically to provide for firefighter safety as part of a landscape-wide and long-term prescribed fire program.

Alternative 5

Alternative 5 responds to the significant issues and concerns identified through public scoping (1.08 Issues). Compared to Alternative 1, it addresses those issues by proposing: planting at a denser 7-foot by 14-foot spacing throughout deer habitat enhancement areas, natural regeneration units and reforestation units that include thinning into an open mosaic structure. This would result in a 6 to 8-foot by 12 to 16-foot spacing when applied on the ground at 444 trees per acre. Alternative 5 does not include prescribed fire post-planting in new plantations. Alternative 5 includes the treatments and actions described below and shown on Map 1, Map 2 and Map 4 (map package). Chapter 2.01 provides more details about each treatment. Table 2.05-1 provides a summary of the proposed activities by alternative. Appendix E (Treatments) provides detailed information related to the specific treatment units in this alternative.

Deer Habitat Enhancement

Alternative 5 includes similar deer habitat enhancement treatments as Alternative 1 on 3,833 acres. Unlike Alternative 1, Alternative 5 plants the 646 acres of deer habitat enhancement areas on 7 by 14-foot spacing and if necessary uses thinning to accomplish the desired mosaic structure. Initiate the thinning as early as 7 years post-planting after the trees have expressed dominance and site occupancy.

Natural Regeneration

The 4,031 acres proposed for natural regeneration under Alternative 1 would be treated using the Alternative 5 reforestation prescription and is included in the acreage listed under reforestation.

Noxious Weed Eradication

Alternative 5 includes similar noxious weed eradication as Alternative 1 on 5,714 acres, emphasizing the use of herbicides. The majority of the noxious weed treatments are within the reforestation units.

Appendix N (Noxious Weed Schedule, project record) displays the implementation schedule for noxious weed eradication under this alternative.

Reforestation

All acreages described under this section do not include reforestation acres proposed for deer habitat enhancement.

Alternative 5 includes similar reforestation treatments as Alternative 1 and includes the 4,031 natural regeneration areas for a total of the same 25,331 acres. Appendix E (Treatments) provides detailed information related to the specific treatment units in this alternative. Appendix R (Reforestation Schedule, project record) displays the implementation schedule for reforestation treatments under this alternative.

SITE PREPARATION

Alternative 5 includes similar site preparation as Alternative 1 on up to 25,331 acres, including the manual application of herbicides. Alternative 5 includes deep till and forest cultivation treatments in the same areas proposed in Alternative 1 (5,085 acres) on slopes up to 35%.

PLANT CONIFERS

Alternative 5 proposes planting conifers on 25,331 acres in the same areas proposed in Alternative 1, including the natural regeneration units. Unlike Alternative 1, Alternative 5 plants all the proposed units and areas on 7 by 14-foot spacing regardless of landscape location and SFMAs. Scalp a 1-foot square area to bare mineral soil prior to digging a hole for the seedling. Integrate existing desired conifers into the prescribed planting pattern, spacing off them the same distance as a planted seedling. Planting will not occur in: natural regeneration areas; oak aggregates; riparian vegetation areas; selected openings; rock outcrops; along cliffs; cultural sites, except where requested by the Tribe; sensitive plant sites; or, on poor soils (low site class). Oak buffers are the same as Alternative 1.

Meadows: Plant conifers outside of meadows and beyond a 25-foot meadow buffer utilizing oaks, seedling mortality and thinning to create the desired mosaic and minimal tree structure adjacent to meadows.

Table 2.02-8 shows the number of conifer trees planted per acre in various landscape positions. It also shows the trees per acre planted as influenced by existing oak trees and the expected survival after 5 years.

Table 2.02-8 Alternative 5: Expected trees per acre with 5 oaks and 25% mortality after 5 years

Tree Spacing	TPA of Planted Seedlings	TPA with 5 Oaks per Acre	TPA with 25% Mortality
7 by 14 feet	444	344	258

RELEASE

Alternative 5 includes similar release treatments as Alternative 1 and includes the additional 4,031 acres of natural regeneration acres to manually apply herbicides (glyphosate) on up to 25,331 acres.

PRESCRIBED FIRE

Unlike Alternative 1, Alternative 5 does not include prescribed fire in new plantations within the first 10 years.

THIN NEW PLANTATIONS

If desired ICO or fuelbreak structure is not created through oak buffers, riparian species, seedling mortality, and other factors, plantations could be thinned to achieve the desired structure based on landscape position and SFMA. Thinning could be initiated as early as 7 years post-planting once the trees have expressed dominance and site occupancy.

Thin Existing Plantations

Alternative 5 includes similar understory burning and thinning on 12,769 acres in existing plantations as described in Alternative 1.

Management Requirements

Alternative 5 includes the same management requirements as Alternative 1 (including those in 2.03 Management Requirements Common to All Action Alternatives) except for the following replacement for the Alternative 1 Soils requirement (item 5).

SOILS

5. Deep Tilling and Forest Cultivation:
    a. On slopes over 20%, maintain at least one 8 to 10-foot vegetated buffer strip for every 100 feet of contour deep tilling or forest cultivation; this area can overlap with the unplanted rows or areas in planting design. In units with only portions identified that are suitable for deep tilling, consult with a soil scientist to assist in delineating these areas on the ground before the work begins.
    b. For deep tilling units with slopes greater than 15%, leave a buffer strip of 12 feet on the downhill side of roads that may concentrate water and drain onto a deep tilled unit.
    c. Deep till followed by forest cultivation on less than 35% slopes.

2.03 MANAGEMENT REQUIREMENTS COMMON TO ALL ACTION ALTERNATIVES

Based on a site specific review of each alternative, resource specialists identified the following management requirements that would be implemented under the action alternatives (1, 3, 4 and 5).

AIR QUALITY

1. Complete all burning under approved burn and smoke management plans. Acquire burn permits from the appropriate county Air Pollution Control District(s) which will determine when burning is allowed. The California Air Resources Board provides daily information on "burn" or "no burn" conditions. Design and implement burn plans to minimize particulate emissions.

AQUATIC SPECIES

2. Limited Operating Periods (LOPs):
    a. Prohibit mechanical operations and herbicide applications within 1 mile of areas identified as suitable California red-legged frog (CRLF) breeding habitat during the wet season (the first rainfall event depositing more than 0.25 inches of rain on or after October 15 until April 15).
    b. Within 300 feet of occupied WPT habitat, prohibit all project activities between May 15 and July 15.
    c. Prohibit equipment operations within 300 feet of Abernathy Meadow and Big and Little Kibbie Ponds from June 1 through July 15 and during periods when these features have no standing water.

3. Aquatic Habitat:
   a. Do not locate burn piles within 100 feet of suitable CRLF breeding habitat or occupied WPT habitat, or within 50 feet of CRLF non-breeding aquatic habitat.
   b. Within 1 mile of suitable CRLF breeding habitat and 300 feet of occupied WPT habitat, ignite all burn piles on only one side, not to exceed half the circumference of the pile, on the side furthest from the nearest aquatic feature.
   c. Do not deep till within 100 feet of aquatic features occupied by WPT unless reviewed by an aquatic biologist.
   d. Use screening devices on water drafting pumps and use pumps with low entry velocity to minimize impacts to aquatic species. A drafting box measuring 2 feet on all sides covered in a maximum of 0.125 inch screening is required.

CULTURAL RESOURCES

4. Project implementation will comply with the stipulations of the Programmatic Agreement Among the United States Forest Service, Stanislaus National Forest, The California State Historic Preservation Officer, and The Advisory Council on Historic Preservation, Regarding the Program of Rim Fire Emergency Recovery Undertakings, Tuolumne County, California (Rim PA).

5. Flag and avoid all eligible and unevaluated cultural resources during implementation except for the following activities which are allowed under the Rim PA:
   a. Allow one-end suspension where tree removal within cultural resource site boundaries is found to benefit and improve site protection. In all cases a cultural resource specialist will be present to direct access within site boundaries.
   b. Non-flammable sites may be burned over. However, consult with the cultural resource specialist to determine if certain cultural features need a reduction in fuel load (e.g. hand thinning) prior to burning.
   c. The cultural resource specialist will identify sites where tree planting will occur within sites, for erosion control or to shield vulnerable site features.

6. Leave in place any tree inadvertently felled into a cultural site boundary until the incident is evaluated by the cultural resource specialist.

7. Construct all piles outside of identified cultural resource site boundaries.

8. Exclude historic sites with wooden remains from the project area or protect during burning using one of the following: hand or dozer constructed firelines, foam wetting agents, or fire shelter fabric.

9. Do not cut line within flagged areas.

10. Remove /cut vegetation away from the sites to reduce flare-up near the site.

11. Where sites are linear and have excessive wooden features, burn away from sites instead of toward them (blackline sites).

12. Notify the cultural resource specialist if a new cultural site is discovered during project implementation, and cease all activities within 150 feet of the resource until consultations are completed.

FIRE AND FUELS

13. Strategic Fire Management Features (SFMF):
    a. Maintain the desired vegetation structure throughout the life of the SFMF on a 5 year rotation and based on site conditions.
    b. Limit woody debris to less than 10 tons per acre on average with a fuel bed depth less than or equal to 12 inches.

   c. Limit the number of down logs greater than 20 inches in diameter to 5 or less logs per acre on average.

14. Strategic Fire Management Areas (SFMA):
   a. Maintain the desired vegetation structure on a 5 to 10 year rotation and based on site conditions.
   b. Limit snags to 6 or less per acre on average. Do not leave snags adjacent to SFMFs or roads.
   c. Limit woody debris to less than 20 tons per acre on average.
   d. Limit the number of down logs greater than 20 inches in diameter to 5 or less logs per acre on average.

INVASIVE PLANTS

15. Reduce risk of weed spread:
   a. All vehicles and equipment that goes off road, clothing, particularly footwear, and transport vehicles must be free of soil, mud (wet or dried), seeds, vegetative matter or other debris that could contain seeds in order to prevent new infestations of noxious weeds in the project area. Dust or very light dirt, which would not contain weed seed, is not a concern.
   b. Treat weed sites prior to implementing mechanical activities, timing the treatments to effectively eliminate seed production in the year of the mechanical activity. Where possible, treat in years prior to the mechanical activity to reduce or eliminate the weed infestations in those sites.
   c. Flag and avoid noxious weed populations if pre-treatment cannot be done. In areas where noxious weeds cover large areas, mechanical treatments can be done within sites, but equipment must be cleaned before leaving the unit.
   d. Do not stage equipment, material or personnel in areas with noxious weed infestations.
   e. After using equipment in infested areas, clean equipment so that it is free of soil, seeds, vegetative matter or other debris prior to being moved off site. Within infested units, conduct project activities in uninfested portions first. In order to move equipment from one infested area to another, the infestations in both areas must be the same species and the new area must have widespread infestations. If both situations are not present, then equipment must be cleaned prior to moving into the next area.
   f. The Forest Service will designate the order, or progression, of unit completion to emphasize treating uninfested units before treating infested units.

RANGE

16. Protect range resources:
   a. Do not plant within 10 feet of rangeland infrastructures.
   b. Repair to Forest Service standards any serviceable or intact infrastructure that is damaged during implementation.
   c. Provide for site stabilization in areas adjacent to meadows that are disturbed by project activities (fuels treatments, thinning, etc.). Use native seed collected locally from within the project area.
   d. Do not schedule treatments (chemical or mechanical) on more than 20% of the capable rangeland in any allotment and no more than 20% of the total allotment area each year. Grazing allotments with a high proportion of area proposed for treatment include Jawbone, Rosasco, Middle Fork, Curtin, and Hunter Creek.

RECREATION

17. Protect recreation resources:
   a. No biomass hauling or spray vehicles on Evergreen Road or Cherry Lake Road: from July 3 through July 5; during Memorial and Labor Day weekends (3:00 p.m. Friday through

Monday); or, on other weekends (3:00 p.m. Friday through Sunday) between Memorial Day and Labor Day.
b. No operations on weekends beginning Memorial Day through Labor Day in areas adjacent to Lost Claim and Sweetwater Campgrounds.
c. Identify and protect National Forest System Trails (NFST) during mechanical operations. Restore trails, if damaged, in kind according to Forest Service standards including the placement of rolling dips.
d. Do not use water sources in developed recreation sites when open to the public.

SENSITIVE PLANTS

18. Protect sensitive plants:
    a. Flag and avoid occurrences of sensitive plants, watchlist plants and forest botanical interest plants. Flag and buffer adequately the occurrences of sun-loving species to avoid future shading by the planted trees.
    b. Flag and avoid known and new occurrences of sensitive plants except as allowed below:
        1. Manual fuel reduction may take place within *Clarkia australis, Clarkia biloba* ssp. *australis, Mimulus filicaulis* or *Mimulus pulchellus* occurrences only during the dry non-growing period. Pile or scatter all material outside sensitive plant occurrences.
        2. Mastication and feller buncher and deep tilling/forest cultivation may be conducted within *Clarkia australis* occurrences only during the dry non-growing period. Do not track masticator through occurrences smaller than 0.25 acre. Minimize tracking in occurrences larger than 0.25 acre. Wherever possible, reach into occurrences with masticator head to conduct the work instead of tracking through.
    c. Plant Douglas-fir adjacent to *Cypripedium montanum* occurrences in order to restore the mycorrhizal fungal partnerships necessary for the survival of the *Cypripedium*.
    d. In order to protect occurrences of *Peltigera gowardii*, conduct project activities near perennial streams in such a way that sediment is not added to or accumulates within occurrences.
    e. Do not allow foot traffic by contractors, forest workers or work inspectors within flagged occurrences.
    f. Protect any new occurrences discovered in the project area.

SOILS

19. Follow Forest Service Manual 2550 Soil Management R5 Supplement (USDA 2012a) and Forest Plan Direction (USDA 2010a) to identify Soil Management Practices (SMPs) that minimize soil impacts.
    a. Limit skidding with rubber-tired or fixed track equipment to slopes less than 35%; limit low ground pressure tracked equipment (e.g. masticator or feller buncher) to less than 45%; limit dozer piling and other (non-deep tilling) mechanical site preparation to less than 30%, or less than 25% on soils with Erosion Hazard Ratings higher than moderate.
    b. Replace or recontour soil when excessive soil displacement occurs.
    c. The soil scientist will monitor ground-based operations occurring between November 1 and June 1 (test for soil moisture and traffic-ability). Ground-based equipment will operate on relatively dry soils of high soil strength, or bearing capacity to prevent soil compaction.
    d. Maintain a well-distributed soil cover of 50% after site preparation, prescribed fire or release treatments on slopes less than 25%. Maintain 60% cover on steeper slopes and within Riparian Conservation Areas (RCAs). Soil cover consists of duff and litter, basal live plant cover, fine woody debris, surface rocks, and downed logs. Deep tilling (subsoiling) and forest cultivation site preparation treatments are excluded from this requirement and fuel's requirements also take priority in order to ensure fuels reduction on these sites.

   e. Where existing ground cover is less than desired, some trees may be felled and left in place or masticated into pieces less than 2 feet in length to reduce potential soil erosion and maintain soil productivity.

20. Mechanical Site Preparation:
   a. Use a brush rake for all dozer piling work. Keep the blade about 6 inches above ground level to prevent soil, litter, and duff material from being piled. Piles should be relatively free of soil (less than 10% soil material), and will be re-spread and rebuilt if they do not meet these specifications.
   b. For deep tilling, ensure that contract specifications plan include the maximum depth of furrowing, a requirement for backblading when the depth of furrowing is exceeded, and winged ripper tool design specifications.
   c. Perform deep tilling when soils are below their plastic limit throughout the top 18 inches. The soil should crumble when attempting to form a 'ribbon' or roll a thread. In addition, for areas with heavy clay content, do not perform deep tilling when soil is dry; this will allow for proper fracturing of soil without creating excessive disturbance. Examples of soils with heavy clay content include: Jocal (Josephine), Sites, Stump Springs, Musick, and Hoda.
   d. Deep till along the contour with slope measured in deep tilled furrows being less than 5%. If contour deep tilling cannot be achieved in some areas, select these as sites for vegetated buffer strips.
   e. Leave a no-till strip below drainage outlets.

TERRESTRIAL WILDLIFE

21. Snags and down woody material:
   a. Snag retention in Old Forest Emphasis Area (OFEA) and Home Range Core Area (HRCA) units: Retain all hardwood snags greater than or equal to 12 inches diameter at breast height (dbh). Retain an average of 30 square feet of basal area of conifer snags across each unit by starting at the largest snag and working down, with a minimum of four and a maximum of 6 per acre. Do not leave snags along roadsides, critical ridge areas, identified fuelbreaks, or within 1 tree length of any infrastructure.
   b. In general forest units and outside of fuelbreaks, retain: 1) all hardwood snags greater than 12 inches dbh; and, 2) retain the largest conifer snags greater than 15 inches dbh at the rate of 4 per acre on a unit basis.
   c. In existing plantation units and outside of fuelbreaks, retain: 1) all hardwood snags greater than 12 inches dbh; and, 2) retain the largest conifer snags available at the rate of 4 per acre on a unit basis.
   d. Retain 5 of the largest down logs per acre on a unit basis. Use logs greater than or equal to 20 inches dbh and at least 20 feet long to meet this requirement where available. Retained down logs should be greater than 100 feet from roadsides.
   e. Retain all conifer snags greater than 15 inches and hardwood snags greater than 12 inches dbh in units GG063, HH014, R037, and R039.
   f. Inside SFMAs; retain up to 6 hardwood snags greater than 15 inches dbh per acre. Minimize damage to re-sprouting oaks when removing hardwood snags by directionally felling away from the largest sprout where feasible and avoiding hitting the stump while moving the downed material.
   g. Retain high capability habitat for black-backed woodpeckers in units HH029, HH031, K013, K018, L002, L003, L005, N010, and N019 eight years post-fire, beginning reforestation efforts no sooner than 2021.

22. Plant blue oaks if needed to supplement natural regeneration in units R041, S004 T021, and T024.

23. Maintain a LOP prohibiting mechanical operations within 0.25 mile of a protected activity center (PAC) during the breeding season for California spotted owls (March 1 through August 15), northern goshawks (February 15 through September 15), great gray owls (March 1 through August 15) and within 0.5 miles of the known bald eagle nest (January 1 through August 31) unless surveys conducted by a Forest Service biologist confirm non-nesting status. LOPs may be reduced to a 0.25 mile area around a nest site if surveys are conducted.
24. Prior to pile burning, coordinate with District Wildlife Biologist to ensure disturbance to sensitive species does not occur.
25. Conduct surveys in compliance with the Pacific Southwest Region's survey protocols to establish or confirm the location of the nest activity center for spotted owl, great gray owl and goshawk.
26. Flag and avoid elderberry plants greater than one inch stem diameter in unit Z030. In unit Z030 and other areas:
    a. Prohibit ground based mechanical operations and burning within 10 feet of flagged elderberry plants.
    b. Prohibit pile burning and mechanical activities within 100 feet of flagged plants from April 1 through June 30 to avoid fire and dust impacts to valley elderberry longhorn beetles.
    c. Notify the District wildlife biologist if additional elderberry plants greater than one inch stem diameter are found prior to or during project implementation.
27. Notify the District Wildlife Biologist if any Federally Threatened, Endangered, Candidate species or any Region 5 Forest Service Sensitive species are discovered during project implementation so that LOPs or other protective measures can be applied, if needed.

VEGETATION

28. Reforestation:
    a. No planting within 100 feet of power lines.
    b. Flag and avoid 0.2 acre research vegetation plots with 20-foot buffers across the project area.
    c. Offset conifer planting 25 feet from all madrone trees, saplings and seedlings.

WATERSHED

29. Protect beneficial uses of water through implementation of Best Management Practices (BMPs) in accordance with Regional Water Quality Management Plan (USDA 2011b) and the National BMPs for Water Quality Management on National Forest System Lands (USDA 2012) and the following requirements.
    a. Follow Forest Plan Direction (USDA 2010a) for protection of Riparian Conservation Areas (RCAs) through compliance with the Riparian Conservation Objectives (RCOs). Table 2.03-1 provides a summary of the operating requirements for mechanical operations in RCAs.
    b. Management Requirements Incorporating BMPs and Forest Plan S&Gs: Table 2.03-2 presents management requirements pertaining to: erosion control plans; operations in RCAs; road activities; log landings; skid trails; water sources; servicing and refueling of equipment; burn piles; prescribed fire; water quality monitoring; and cumulative watershed effects.

Table 2.03-1 Operating requirements for mechanized equipment operations in RCAs

Stream Type[1]	Zone	Width (feet)	MECH[2]	SKID[3]	Operating Requirements
PER/INT/SAF	Exclusion[4]	0-15	Prohibited	Prohibited	N/A
PER/INT/SAF	Exclusion	15-50	Allowed	Prohibited	N/A
PER/INT/SAF	Transition	15-50	Allowed	Prohibited	Remove operation-created debris from stream channels unless prescribed for resource benefit. Retain remaining obligate riparian shrubs and trees (e.g. willows, alder, aspen). Do not damage streambanks with equipment and retain sufficient vegetation to maintain streambank stability.
PER/INT/SAF	Transition	50-100	Allowed	Allowed	Use existing skid trails except where unacceptable impact would result. The number of crossings should not exceed an average of 2 per mile.
PER/SAF	Outer	100-300	Allowed	Allowed	Density and intensity of skid trails will gradually increase as distance increases from the Transition Zone.
INT	Outer	100-150	Allowed	Allowed	Density and intensity of skid trails will gradually increase as distance increases from the Transition Zone.
EPH	Exclusion[5]	0-15	Prohibited	Prohibited	N/A
EPH	Exclusion	15-25	Allowed	Prohibited	N/A
EPH	Transition	25-50	Allowed	Allowed	The number of crossings should not exceed an average of 3 per mile.

[1] PER=Perennial; INT=Intermittent; EPH=Ephemeral; SAF=Special Aquatics Features (lakes, meadows, bogs, fens, wetlands, vernal pools, and springs)

[2] MECH=Mechanical Harvesting or Shredding (low ground pressure track-laying machines such as feller bunchers and masticators)

[3] SKID=Skidding (rubber-tired skidders and track laying tractors)

[4] The exclusion zone for perennial/intermittent streams starts at: A. The edge of the active channel where slopes rise uniformly from the stream, or at the outer edge of the following features, whichever is the furthest from the stream. B. The first slope-break adjacent to the stream (e.g., stream bank, inner gorge). C. Flat or nearly flat ground adjacent to the channel (e.g., floodplain or terrace). D. Obligate riparian shrub and/or tree communities associated with any of the above. The exclusion zone for SAFs begins at: A. The outer edge of obligate trees, shrubs or herbaceous plants in wet meadows, bogs, fens and springs, or the high water line of lakes and vernal pools. B. The top of the first slope-break immediately adjacent to the special aquatic feature if further than the obligate vegetation or high water line.

[5] The exclusion zone begins at the edge of the channel where slopes rise uniformly or at the edge of the stream bank, whichever is furthest from the stream.

Table 2.03-2 Management requirements incorporating BMPs and Forest Plan S&Gs

Management Requirements	BMPs/Forest Plan[1]/Locations
Erosion Control Plan - Prepare a project area Erosion Control Plan (USDA 2011b) approved by the Forest Supervisor prior to the commencement of any ground-disturbing project activities. Prepare a BMP checklist before implementation.	**Regional BMPs** 2-13 Erosion Control Plans (roads and other activities) 1-13 Erosion Prevention and Control Measures During Operations 1-21 Acceptance of Timber Sale Erosion Control Measures before Sale Closure **National Core BMPs** Veg-2 Erosion Prevention and Control **Forest Plan S&Gs** 194 (RCO 4) **Locations**: all areas where ground-disturbing activities occur.
Operations in Riparian Conservation Areas - Delineate riparian buffers (Table 2.03-1) within RCAs around all streams and special aquatic features within project treatment units. - Fell trees harvested within RCAs directionally away from stream channels and SAFs unless otherwise recommended by a hydrologist or biologist. - A minimum of 60% well distributed ground cover is desired within 100 feet of perennial and intermittent streams and SAFs.	**Regional BMPs** 1-4 Using Sale Area Maps and/or Project Maps for Designating Water Quality Protection Needs 1-8 Streamside Zone Designation 1-10 Tractor Skidding Design 1-18 Meadow Protection During Timber Harvesting 1-19 Streamcourse and Aquatic Protection

Management Requirements	BMPs/Forest Plan[1]/Locations
- Project administrator shall coordinate with a hydrologist prior to operating in units BB035, BB050, and BB036 to protect the Bear Gully restoration site, the stream channel downstream of the site, and the alluvial flat. - Exclude mechanized equipment between the near-stream roads that closely parallel both sides of Corral Creek in Units R037 and T005 (1N01 and 1N08 on the west, and 1N74 and 1N74C on the east) unless otherwise recommended by a hydrologist or soil scientist. - Planting: For perennial and intermittent streams, do not plant within 15 feet of the streambank or 20 feet of their associated riparian vegetation, whichever is more. - Exclude dozer operations within 50 feet from the start of the exclusion zone for all perennial and intermittent and SAFs and 25 feet from the start of the exclusion zone for all ephemerals.	5-3 Tractor Operation Limitations in Wetlands and Meadows 5-5 Disposal of Organic Debris 7-3 Protection of Wetlands **National Core BMPs** Aq Eco-2 Operations in Aquatic Ecosystems Plan-3 Aquatic Management Zone Planning Veg-1 Vegetation Management Planning Veg-2 Erosion Prevention and Control Veg-3 Aquatic Management Zones Veg-4 Ground-Based Skidding and Yarding Operations **Forest Plan S&Gs** 193 (RCO 2) 194 (RCO 3) 194 (RCO 4) 195 (RCO 5) **Locations**: All units containing RCAs and SAFs, and specifically the portions of units mentioned in this section.
Road Construction and Reconstruction - Maintain functioning erosion-control measures during road construction and reconstruction and in accordance with the erosion control plan. - Stabilize disturbed areas with mulch, erosion fabric, vegetation, rock, large organic material, engineered structures, or other measures according to specifications in the erosion control plan.	**Regional BMPs** 2-2 General Guidelines for the Location and Design of Roads 2-3 Road Construction and Reconstruction 2-8 Stream Crossings 2-13 Erosion Control Plans (roads and other activities) **National Core BMPs** Road-3 Road Construction and Reconstruction **Forest Plan S&Gs** 62 193 (RCO 2) 194 (RCO 4) **Locations**: all roads to be reconstructed.
Road Maintenance and Operations - Maintain road surfaces to dissipate intercepted water in a uniform manner along the road by outsloping with rolling dips, insloping with drains or crowning with drains. Where feasible and consistent with protecting public safety, utilize outsloping and rolling the grade (rolling dips) as the primary drainage technique. - Adjust surface drainage structures to minimize hydrologic connectivity by: discharging road runoff to areas of high infiltration and high surface roughness, armoring drainage outlets to prevent gully initiation, and increasing the number of drainage facilities within RCAs.	**Regional BMPs** 2-4 Road Maintenance and Operations 2-13 Erosion Control Plans (roads and other activities) **National Core BMPs** Road-4 Road Operations and Maintenance Veg-2 Erosion Prevention and Control **Forest Plan S&Gs** 193 (RCO 2) 194 (RCO 4) **Locations**: all roads with maintenance or project use.
Log Landings - Re-use log landings to the extent feasible. - Do not construct new landings within 100 feet of perennial or intermittent streams and SAFs or 50 feet of ephemeral streams. - Deep till all landings when biomass operations are complete.	**Regional BMPs** 1-12 Log Landing Location 1-16 Log Landing Erosion **National Core BMPs** Veg-6 Landings Veg-2 Erosion Prevention and Control **Forest Plan S&Gs** 194 (RCO 4) **Locations**: Biomass Removal: all landings.
Skid Trails - Use existing skid trails wherever possible, except where unacceptable resource damage may result. Locate skid trails at least 50 feet from perennial and intermittent streams and SAFs and 25 feet from ephemeral streams.	**Regional BMPs** 1-10 Tractor Skidding Design 1-17 Erosion Control on Skid Trails **National Core BMPs**

Management Requirements	BMPs/Forest Plan[1]/Locations
- Install waterbars and other erosion control measures as needed on skid trails immediately following completion of biomass operations. - Remove skid trails berms that concentrated flows to improve surface drainage following use.	Veg-2 Erosion Prevention and Control Veg-4 Ground-Based Skidding and Yarding Operations **Forest Plan S&Gs** 194 (RCO 4) **Locations**: all ground-based yarding system units.
Water Sources - For water drafting on fish-bearing streams: do not exceed 350 gallons per minute for streamflow greater than or equal to 4.0 cubic feet per second (cfs); do not exceed 20 percent of surface flows below 4.0 cfs; and, cease drafting when bypass surface flow drops below 1.5 cfs. - For water drafting on non-fish-bearing streams: do not exceed 350 gallons per minute for streamflow greater than or equal to 2.0 cfs; do not exceed 50 percent of surface flow; and, cease drafting when bypass surface flow drops below 10 gallons per minute.	**Regional BMPs** 2-5 Water Source Development and Utilization 2-13 Erosion Control Plans (roads and other activities) **National Core BMPs** WatUses-3 Administrative Water Developments AqEco-2 Operations in Aquatic Ecosystems **Forest Plan S&Gs** 193 (RCO 2) 194 (RCO 4) **Locations**: all water drafting sites.
Servicing, Refueling, and Cleaning Equipment and Parking/Staging Areas - Allow temporary refueling and servicing only at approved sites located outside of RCAs. - Rehabilitate temporary staging, parking, and refueling/servicing areas immediately following use. - A Spill Prevention and Containment and Counter Measures (SPCC) plan is required where total oil products on site in above-ground storage tanks exceed 1320 gallons or where a single container exceeds 660 gallons. Review and ensure spill plans are up-to-date. - Report spills and initiate appropriate clean-up action in accordance with applicable State and Federal laws, rules and regulations. The Forest Service's hazardous materials coordinator's name and phone number shall be available to Forest Service personnel who administer or manage activities utilizing petroleum-powered equipment. - Remove contaminated soil and other material from NFS lands and dispose of this material in a manner according to controlling regulations.	**Regional BMPs** 2-10 Parking and Staging Areas 2-11 Equipment Refueling and Servicing **National Core BMPs** Road-9 Parking and Staging Areas Road-10 Equipment Refueling and Servicing Fac-7 Vehicle and Equipment Wash Water **Forest Plan S&Gs** 193 (RCO 1) **Locations**: designated temporary refueling, servicing and cleaning sites and parking/staging areas.
Burn Piles - Place burn piles a minimum of 50 feet away from perennial and intermittent streams and SAFs and 25 feet from ephemeral streams. Locate piles outside areas that may receive runoff from roads. - Avoid disturbance to obligate riparian vegetation. - Do not dozer pile in sensitive watershed areas and on areas where mastication or drop and lop were prescribed under the Rim Recovery project. Grapple piling[2] is allowed in these areas, but is subject to the mechanized equipment restrictions for RCAs. When grapple piling in sensitive watershed areas, consult a hydrologist or soil scientist if less than 70% ground cover would be retained. **Prescribed Fire** - Avoid damage to obligate riparian vegetation (e.g., willows, alders, cottonwoods). - Do not burn over Bear Gully restoration site (contained in parts of units BB035, BB050, and BB036). - In order to maintain the wood component or temporary fences proposed under the Rim Rehabilitation and the Rim Habitat projects, coordinate with a hydrologist prior to conducting prescribed fire on the following units: M024, M021, M019, M016, R025, R033, I062, I063, I067, N019, T017, T022, S004, Y030, Y027, BB011, I131, I132, I137, M008, R041, R042, R034, Z011, AA001. - Maintain a minimum of 60% ground cover within 100 feet of perennial and intermittent streams and 50 feet of ephemeral streams. - Avoid direct ignition within RCAs, including ephemeral channels; fire may back into the riparian area as long as ground cover is maintained. - Avoid constructing fire lines within RCAs unless there is no alternative. Do not construct new dozer lines within 100 feet of perennial and intermittent streams and 50 feet of ephemeral streams.	**Regional BMPs** 6-2 Consideration of Water Quality in Formulating Fire Prescriptions 6-3 Protection of Water Quality from Prescribed Burning Effects **National Core BMPs** Fire-1 Wildland Fire Management Planning Fire-2 Use of Prescribed Fire **Forest Plan S&Gs** 194 (RCO 4) **Locations**: all pile burning areas, sensitive watershed areas. All units that are planned for prescribed fire.

Management Requirements	BMPs/Forest Plan[1]/Locations
- Restore constructed fire lines upon completion of prescribed burning and/or prior to each winter when fire lines are exposed to the potential for erosion. - Restoration should consist of water barring hand and dozer lines, re-contouring of benched trails, and deep tilling of detrimentally compacted dozer lines. - No debris or soil that might impede water flow or cause stream bank degradation will be placed in any stream. - Do not bulldoze the surface within SMZs or near streams. Favor hand tools and equipment on steep slopes, fragile soils and in sensitive areas such as Streamside Management Zones. - Install fire lines on the contour as much as possible.	
Water Quality Monitoring - Conduct implementation and effectiveness monitoring using the Best Management Practices Evaluation Program (BMPEP) (USDA 2002) and the National Core Monitoring Protocols (FS-990b) (USDA 2012).	**Regional BMPs** 7-6 Water Quality Monitoring **Locations**: Monitoring locations will be detailed in a project monitoring plan.
Cumulative Watershed Effects (CWE) Analysis - CWE analysis will be conducted for the project.	**Regional BMPs** 7-8 Cumulative Off-Site Watershed Effects **Locations**: All activities within the project watersheds will be analyzed

[1] Forest Plan S&Gs indicate page number from Forest Plan Direction (USDA 2010a).
[2] Grapple piling is a site preparation technique that uses tracked excavator type equipment with an articulating arm equipped with a clam type pincher head that lifts and piles brush and logs. Usually followed by jackpot burning.

2.04 Alternatives Considered but Eliminated from Detailed Study

NEPA requires that federal agencies rigorously explore and objectively evaluate all reasonable alternatives and briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments and internal scoping suggested the alternatives described below along with the reasons for eliminating them from detailed study.

a. Natural Succession

This alternative, based on scoping comments, would allow the forest to recover naturally. This differs from “No Action” by including measures to thin existing plantations. Natural forest recovery occurs through recruitment of new populations from adjacent seed sources rather than planted seedlings. It was considered but eliminated from detailed study for the following reasons:

- It does not meet the purpose and need to restore old forest for wildlife habitat and connectivity. Some wildlife species rely on dense canopy closure for forage, cover, and nesting. This habitat would only be suitable for early-seral-stage dependent wildlife species.
- It does not meet the purpose and need to return mixed conifer forest to the landscape since many large areas within the burn do not have mature trees to provide a seed source for recruiting seedlings.
- It does not meet the purpose and need of reducing fuels for future forest resiliency. About 6,200 acres of needed fuel treatments would not occur with this alternative. The large amount of fuel in these areas would make future fires difficult to manage and contain, jeopardizing future vegetation resiliency and fire fighter safety.
- Eradicating noxious weeds associated with the proposed reforestation units would not occur on 5,714 acres.

b. Natural Regeneration with Founder Stands

This alternative, based on scoping comments, would allow much of the forest to recover naturally. Outside complex early seral forest, plant founder stands: small variable-shaped areas less than 2 acres in size within a larger (10-acre total) area. On each of the 2 acres, plant 40 5-tree clusters spaced 6 feet between each tree and spaced 33 feet apart. Planting would not occur within 1,000 feet of an established conifer. On areas where no natural regeneration occurs, between 1,000 and 2,000 feet from established conifers, reforest 63 acres beginning 5 years after the 2013 Rim Fire. Only 20% of the 63 acres (i.e., 13 acres) would be planted. It was considered but eliminated from detailed study for the following reasons:

- Very few acres were proposed for planting.
- It does not meet the purpose and need to restore old forest for wildlife habitat and connectivity. Some wildlife species rely on dense canopy closure for forage, cover, and nesting. This habitat would only be suitable for early-seral-stage dependent wildlife species.
- It does not meet the purpose and need to return mixed conifer forest to the landscape since it does not promote the quick reestablishment of conifers. The fewer trees planted results in fewer opportunities for trees to grow in the best soil and water microsite conditions.
- The units would not meet stocking levels set by the Region or those approved by the Stanislaus National Forest Certified Silviculturist based on site specific growth modeling done for this project. It is expected that 25% to 70% of the planted trees would die within 5 years resulting in understocked stands.
- It does not meet the Forest Plan Direction for old forest ecosystems to restore forest species composition and structure following large scale, stand-replacing disturbance events.

c. Natural Regeneration with Founder Stands with tighter buffers

This alternative, based on scoping comments is similar to “b” above. The only difference is the distance to planting areas adjacent to established cone producing conifers. Planting would not occur within 500 feet of established conifers. On areas between 500 and 1,000 feet from established conifers where no natural regeneration has occurs, reforest 20% of 866 acres (173 acres) beginning 5 years after the 2013 Rim Fire using the founder stand guidelines. When natural regeneration is not occurring in areas greater than 1,000 feet from live conifer trees, reforest immediately to create founder stands on up to 20% of 47 acres (9 acres). It was considered but eliminated from detailed study for the following reasons:

- Very few acres were proposed for planting.
- It does not meet the purpose and need to restore old forest for wildlife habitat and connectivity. Some wildlife species rely on dense canopy closure for forage, cover, and nesting. This habitat would only be suitable for early-seral-stage dependent wildlife species.
- It does not meet the purpose and need to return mixed conifer forest to the landscape since it does not promote the quick reestablishment of conifers. The fewer trees planted results in less opportunities for trees to grow in the best soil and water microsite conditions.
- The units would not meet stocking levels set by the Region or those approved by the Stanislaus National Forest Certified Silviculturist based on site specific growth modeling done for this project. It is expected that 25% to 70% of the trees would die within 5 years resulting in understocked stands.
- It does not meet the Forest Plan Direction for old forest ecosystems to restore forest species composition and structure following large scale, stand-replacing disturbance events.

d. Low Density Planting (Plant 40 to 100 Trees per Acre)

This alternative, based on scoping comments, would incorporate selected aspects of Alternative 1 (Proposed Action). This alternative would plant fewer trees per acre to provide an open pre-settlement condition.). It was considered but eliminated from detailed study for the following reasons:

- It does not meet the purpose and need to restore old forest for wildlife habitat and connectivity. Some wildlife species rely on dense canopy closure for forage, cover, and nesting. This habitat would only be suitable for early-seral-stage dependent wildlife species.

- It does not meet the purpose and need to return mixed conifer forest to the landscape since it does not promote the quick reestablishment of conifers. The fewer trees planted results in fewer opportunities for trees to grow in the best soil and water microsite conditions.
- The units would not meet stocking levels set by the Region or those approved by the Stanislaus National Forest Certified Silviculturist based on site specific growth modeling done for this project. It is expected that up to 25% of the planted trees would die within 5 years resulting in understocked stands.
- It does not meet the Forest Plan Direction for old forest ecosystems to restore forest species composition and structure following large scale, stand-replacing disturbance events.

e. Maximum Acres of Planting

This alternative, based on scoping comments, would plant all possible areas identified on photos as lacking conifers. Forest recovery occurs through recruitment of new populations from planted augmentation. It was considered but eliminated from detailed study for the following reasons:

- Poor site conditions for growing conifers such as: existing meadow, poor soil, rocky sites, hot dry south-facing slope, steep slopes difficult to maintain, poor access, identified as an area that reburns frequently, fuelbreak locations, wilderness, near natural or Wild and Scenic River corridors.
- Small existing openings with adjacent green trees are within the realm of natural variation and provide diversity on the landscape.
- Already has decent stocking.

f. One Herbicide Application

This alternative, based on scoping comments, would incorporate selected aspects of Alternative 1 (Proposed Action). Glyphosate spraying would be limited to either a single site preparation treatment, and then rely entirely on hand grubbing or tree growth to out-perform competition, or to use alternative site preparation techniques coupled with a single herbicide release treatment in year 1 or 2 to give the newly planted tree a boost against competition. It was considered but eliminated from detailed study for the following reason:

- It is similar to an alternative already considered in detail (Alternative 1) with effects within the range of the alternative already considered in detail.

g. Two Herbicide Applications

This alternative, based on scoping comments, would incorporate selected aspects of Alternative 1 (Proposed Action). A maximum of two spray treatments would occur across every acre planted. This option would allow no more than one site preparation treatment and one release treatment. It was considered but eliminated from detailed study for the following reason:

- It is similar to an alternative already considered in detail (Alternative 1) with effects within the range of the alternative already considered in detail.

h. Spray Areas with 40% or More Bearclover (two applications)

This alternative, based on scoping comments, would incorporate selected aspects of Alternative 1 (Proposed Action). Glyphosate would only be applied in stands where bearclover covered 40% or more of each acre to be planted or 40% of the overall planting unit; and, only for both site preparation and a single release treatment in the year chosen by Forest staff as most essential for survival based on field visits for a maximum of two applications. It was considered but eliminated from detailed study for the following reason:

- It is similar to an alternative already considered in detail (Alternative 1) with effects within the range of the alternative already considered in detail.

2.05 Comparison of the Alternatives

Chapter 3 describes the environmental consequences of the alternatives. This section compares the alternatives by providing summary tables showing the key differences between alternatives. The Alternative Comparison Map (project record) displays the locations of treatments considered in all action alternatives. Table 2.05-1 compares the alternatives by proposed action group identified in Chapter 2.01. Table 2.05-2 compares the alternatives with a summary of the proposed reforestation treatments. Table 2.05-3 compares the alternatives planted conifer TPA and the expected survival. Table 2.05-4 compares the alternatives with a summary of proposed fuelbreak and other key fire areas.

Table 2.05-1 Comparison of Alternatives: Proposed Treatments

Proposed Treatments (acres)	**Alternative 1** (Proposed Action)	**Alternative 2** (No Action)	**Alternative 3**	**Alternative 4**	**Alternative 5**
Deer habitat enhancement	3,833	0	3,833	1,164	3,833
Natural regeneration	4,031	0	4,031	22,464	0
Noxious weed eradication	5,714	0	3,131	3,131	5,714
Reforestation	21,300	0	21,300	2,867	25,331
Thin existing plantations	12,769	0	12,769	12,769	12,769
Prescribed fire only	0	0	0	34,344	0

Table 2.05-2 Comparison of Alternatives: Reforestation Treatments outside Deer Habitat Enhancement

Proposed Treatments (acres)	**Alternative 1** (Proposed Action)	**Alternative 2** (No Action)	**Alternative 3**	**Alternative 4**	**Alternative 5**
Feller buncher	3,139	**0**	3,139	140	3,318
Feller buncher and mastication	351	**0**	351	0	423
Hand cut, hand pile and burn	74	**0**	74	0	271
Hand cut, prescribed fire (understory and jackpot)	237	**0**	237	51	237
Machine pile and burn	912	**0**	912	76	925
Mastication	1,493	**0**	1,493	32	1,528
Total Initial Site Preparation	**6,206**	**0**	**6,206**	**299**	**6,704**
Deep till and forest cultivate	5,085	0	8,893	0	5,085
Manually apply herbicides (Glyphosate)	16,215[1]	0	0	2,867	20,246
Total Site Preparation	**21,300**	**0**	**8,893**	**2,867**	**25,331**
Total Plant	**21,300**	**0**	**21,300**	**2,867**	**25,331**
Release with grubbing	0	0	21,300[2]	0	0
Release with glyphosate	21,300	0	0	4,012[3]	25,331
Total Release	**21,300**		**42,600**	**4,012**	**25,331**
Total Prescribed Fire at Year 10	**21,300**	**0**	**21,300**	**0**	**0**
Total Thin New Plantations	**0**	**0**	**0**	**0**	**25,331**[4]
Additional Prescribed Fire in First Decade				**17,172**	

[1] Does not include proposed 4,031 acres of natural regeneration units that may have herbicide treatment.
[2] Hand release would be required twice annually on the same acres for most competing species.
[3] Release with glyphosate acreage includes treatment of the buffer adjacent to the planted areas.
[4] Thin plantations where needed to create desired ICO structure and to meet fire and fuels structure goals.

Table 2.05-3 Comparison of Alternatives: Planted Conifer TPA and Expected Survival

Landscape Position	Alternative 1 (Proposed Action)	Alternative 3	Alternative 4	Alternative 5
Emergency Travel Routes	152	152	0	444
Fuelbreak	176	151	0	444
Primary Ridge	194	194	0	444
Minimum TPA Planted (mid-slopes)	210	244	100	444
Maximum TPA Planted (mid-slopes)	303	514	200	444
Maximum Planted TPA with 5 Oaks per Acre	235	398	N/A	344
Expected Maximum Planted Conifer TPA after mortality[1]	176	199	150	258

[1] With the competing vegetation control methods, at year 5 the expected mortality is 25% for Alternatives 1, 4 and 5 (herbicides) and 50% for Alternative 3 (grubbing).

Table 2.05-4 Comparison of Alternatives: Fuelbreaks and Other Key Fire Areas

Landscape Position	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3	Alternative 4	Alternative 5
Fuelbreaks	30-foot no plant strip centered in middle with 150 feet on each side planted with 13 to 17-foot spaced conifers (176 trees per acre) creating a 330 foot wide strip.	No SFMFs implemented.	90 feet across bordered by 80 feet of 15-foot by 15-foot planting on each side for a total width of 250 feet. Plant one row of 4-tree micro-clusters (14 feet between outside trees, 7 feet to middle tree and 26 feet between cluster centers) leaving about 32 feet of no-plant area on each side before beginning 15-foot by 15-foot spaced planting pattern (150 trees per acre). Where roads are present in center of fuelbreak, alternate planting of 4-tree micro-clusters on each side of road beginning 12 feet off of road edge.	No Planting	No SFMFs implemented with initial planting.
Primary Ridges Within SFMA	Same as Fuelbreaks.	No SFMFs implemented.	Same as Fuelbreaks.	No Planting	No SFMFs implemented with initial planting.
Primary Ridges Outside SFMA	13 to 17-foot spaced conifers in a 250-foot wide strip (194 trees per acre).	No SFMFs implemented.	Same as 1.	No Planting	No SFMFs implemented with initial planting.
Emergency Travel Routes	12 to 16-foot spaced 20-tree pyramid (no top, Figure 2.02-2). Starts 12 feet from road and ends 68 feet from road (152 trees per acre).	No SFMFs implemented.	Same as 1.	No Planting	No SFMFs implemented with initial planting.

SFMA=Strategic Fire Management Area; SFMF=Strategic Fire Management Feature

Table 2.05-5 provides a summary comparison of effects for selected indicators under each alternative. Chapter 3 includes additional details.

Table 2.05-5 Comparison of Alternatives: Summary of Effects

Resource and Indicator	**Alternative 1** (Proposed Action)	**Alternative 2** (No Action)	**Alternative 3**	**Alternative 4**	**Alternative 5**
Air Quality: Smoke emissions from broadcast and machine pile burning	Minimal effects to local communities and Yosemite.	Wildfire emissions would impact sensitive groups.	Same as 1.	Similar to 1, but more smoke from burning.	Same as 1.
Aquatic T&E: California red-legged frog; Sierra Nevada yellow-legged frog	Effects to habitat from ground disturbance, fire and herbicides. Effects to individuals highly unlikely due to probable absence.	No effects to individuals.	Similar to 1, but no herbicide use.	Similar to 1, but on fewer acres.	Similar to 1, but chance of increased sediment.
Aquatic Sensitive: Foothill Yellow-legged frog; Hardhead; Western pond turtle	Effects to habitat and individuals from ground disturbance, fire and herbicides.	No effects to individuals.	Similar to 1, but increased sedimentation and no herbicides.	Similar to 1, but on fewer acres and reduced herbicides.	Similar to 1, but chance of increased sediment.
Cultural Resources: Exposure and integrity of prehistoric and historic sites.	No effects due to following Rim PA and limited herbicide use in prehistoric sites.	Indirect effects on fragile sites from fire-weakened trees.	Similar to 1, but increased site prep may uncover unknown cultural sites.	Similar to 1, but reduced site prep and increased burning may impact historic sites.	Same as 1.
Fire and Fuels: Fire Behavior	Reduced fire effects in treated areas.	Indirect effects may create difficult wildfire behavior.	Same as 1.	Same as 1.	Same as 1.
Fire and Fuels: Strategic Fire Management Features	Beneficial effects from fuelbreaks, primary ridge treatments and emergency travel routes.	Indirect effects may create difficult fire management.	Similar to 1, but slightly less beneficial effects.	Same as 2.	Same as 1.
Invasive Species: Risk of Spread	Moderate	High	High	High	Moderate
Invasive Species: Eradication	High	None	Moderate	Moderate	High
Range: Impacts to range vegetation, administration, livestock movement and infrastructure	Short-term negative effects to vegetation and livestock movement. Long-term benefits from noxious weed control.	Indirect effects to vegetation, administration, livestock movement and infrastructure.	Similar to 1, but increased effects to livestock movement and no noxious weed control benefits.	Similar to 1, but no noxious weed control benefits.	Same as 1.
Recreation: Short-term loss of recreation opportunities	Short-term effects from herbicides; sights and sounds of machinery or workers; closures or travel delays; and, smoke.	None	Similar to 1, but longer impacts from machinery or workers.	Similar to 1, but diminished in scope.	Similar to 1, but with less smoke impacts.
Recreation: Long-term loss of recreation opportunity	Beneficial effects from increased forest resiliency and reduced wildfire risk. Recreation patterns may shift to other areas.	Indirect effects from weeds, wildfire risk and loss of shade in favorite areas.	Similar to 1, but increased effects on dispersed use.	Same as 1 in treated areas. Same as 2 in areas not treated.	Same as 1.

Resource and Indicator	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3	Alternative 4	Alternative 5
Sensitive Plants	May affect individuals, but is not likely to result in a trend toward federal listing or loss of species viability.	Same as 1.	Same as 1.	Same as 1.	Same as 1.
Society: Present Net Value	($75,134,000)	$1,871,000	($229,626,000)	($28,042,000)	($72,294,000)
Society: Total Jobs Supported (in FTEs)	2,369	0	7,764	283	2,302
Soils: Soil Stability	Increased short-term erosion risk. High EHR in 14% of treated areas.	Lowest short-term erosion risk. Low to Moderate EHR only.	Highest short-term erosion risk. High EHR in 22% of treated areas.	Similar to 2, but slightly higher erosion risk. High EHR in 2% of treated areas.	Similar to 1, but slightly higher erosion risk.
Soils: Surface Organic Matter and Soil Organic Matter (SOM)	Reduced surface organic matter. Short-term increase and possible long-term decrease in SOM.	None	Similar to 1, but most reduction in surface organic matter.	Similar to 1, but least reduction in surface organic matter (best cover) and least impact to SOM.	Similar to 1, but more surface organic matter.
Special Areas: Wilderness Character	Short-term effects from drift smoke and sights and sounds of machinery or workers near Wilderness boundary.	None	Same as 1.	Similar to 1, but more smoke impacts.	Similar to 1, but less smoke impacts.
Vegetation: Average conifer DBH at year 20 (inches)	4.3	1.7	2.8	1.9	4.3
Vegetation: Average conifer height at year 20 (feet)	23.2	12.4	16.3	13.1	23.6
Vegetation: Future potential timber yield (million board feet)	163	42	48	42	160
Watershed: Erosion and Sedimentation (Thinning and Site Preparation Activities)	Creation of sediment transport networks.	No new sediment transport networks created; hydrological and erosional responses to the Rim Fire would still occur; existing skid trail sediment transport networks remain.	Slight increase in ground disturbance and the potential of erosion and sediment delivery to streams 1.	Dramatic reduction in the creation of effective sediment transport networks. Much less potential for erosion and sedimentation than 1.	Same as 1.
Watershed: Riparian Vegetation	Slight beneficial effects to riparian obligate species, SAFs and meadows.	No disturbance to riparian species. Indirect effects from lack of sunlight and weed control.	Similar to 1, but less weed control.	Same as 3.	Same as 1.
Watershed: Stream Condition	Beneficial effects from restoration improving hillslope and riparian functions.	Indirect effects from continued loss of hillslope and riparian functions.	Same as 1.	Similar to 1, but on fewer acres.	Same as 1.
Watershed: Water Quality (Beneficial Uses of Water)	No effects to water temperature or beneficial uses. Beneficial effects from accelerated return to conifer forest. Low potential for herbicides to contaminate water.	None	Similar to 1, but no herbicides.	Similar to 1, but less return to conifer forest and herbicides.	Same as 1.

Resource and Indicator	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3	Alternative 4	Alternative 5
Wildlife T&E: Valley elderberry longhorn beetle	May affect but is not likely to adversely affect; will not affect Designated Critical Habitat.	Same as 1.	Same as 1.	Same as 1.	Same as 1.
Wildlife Proposed T&E: Fisher	May affect but is not likely to jeopardize continued existence.	Same as 1.	Same as 1.	Same as 1.	Same as 1.
Wildlife Sensitive: Bald eagle; California spotted owl; Great gray owl; Northern goshawk; Pacific marten; Pallid bat, fringed myotis, and Townsend's big-eared bat; Western Bumble Bee	May affect individuals but is not likely to result in a trend toward federal listing or loss of viability.	Same as 1.	Same as 1.	Same as 1.	Same as 1.
Wildlife: Black-backed woodpecker	Retains 76 percent of modeled pairs.	Retains 100 percent of modeled pairs.	Same as 1.	Same as 2.	Same as 1.
Wildlife: Mule deer	Improves 7,000 acres of critical winter deer range.	No improved critical winter deer range.	Same as 1.	Improves 3,200 acres of critical winter deer range.	Same as 1.

3. Affected Environment and Environmental Consequences

Chapter 3 presents the scientific and analytical basis for the comparison of alternatives presented in Chapter 2. This Chapter contains 20 sections, including 15 resource sections (3.02 Air Quality through 3.16 Wildlife) that summarize the physical, biological, social, and economic environments affected by the proposed action and alternatives and the effects on that environment that would result from implementation of the alternatives considered in detail:

3.01 Introduction
3.02 Air Quality
3.03 Aquatic Species
3.04 Cultural Resources
3.05 Fire and Fuels
3.06 Invasive Species
3.07 Range
3.08 Recreation
3.09 Sensitive Plants
3.10 Society, Culture and Economy
3.11 Soils
3.12 Special Areas
3.13 Vegetation
3.14 Visual Resources
3.15 Watershed
3.16 Wildlife
3.17 Short-Term Uses and Long-Term Productivity
3.18 Unavoidable Adverse Effects
3.19 Irreversible and Irretrievable Commitments of Resources
3.20 Other Required Disclosures

3.01 Introduction

This section provides an overview of the: Affected Environment; Effects Analysis Process; Forest Plan Direction; Incomplete or Unavailable Information; Information on Other Resource Issues; NEPA and CEQA compliance; and, Resource Reports.

Affected Environment

All resources share many aspects of the affected environment. The following general elements of the affected environment are provided to avoid repetition in each resource section.

The 400-square-mile Rim Fire encompasses a diverse and complex landscape. Landforms within the Rim Fire area are dramatic, punctuated by river canyons, glaciation, a lava cap and large expanses of gentle to moderately steep slopes. Geology is varied and includes all three of the principal geologic types in the Sierra Nevada mountain range. Metamorphic rock occupies much of the lower elevations and the Sierra granitic batholith and relic volcanic flows generally occur at higher elevations. The watersheds, rising in elevation from about 2,000 to 7,000 feet, include rock-rimmed river canyons, mountain meadows, major rivers and small secluded streams. Oak grasslands occur at the lowest elevations, with large expanses of mixed conifer forests at mid-elevation and even some red fir-lodgepole pine stands growing at the highest elevations. Cottonwoods and quaking aspens occupy occasional streamside and meadow sites at mid-to-high elevations. As in many areas of the Sierra Nevada, the landscape was heavily influenced over the last 150 years by past management activities including; mining, grazing, fire exclusion, large high-severity fires and drought. Railroad logging also occurred throughout the area and almost all of the burned forest consists of second growth trees.

The Rim Fire area lies within a Mediterranean climate zone consisting of warm, mostly dry summers and cool, wet winters. Average summer high temperatures are about 95 degrees Fahrenheit at the lowest elevations and 75 degrees Fahrenheit at higher elevations. Average low winter temperatures are about 30 to 20 degrees Fahrenheit at the lowest and highest elevations respectively. Extreme high and low temperatures vary about 10 to 15 degrees from average. Precipitation increases in elevation, with a range of about 30 to 50 inches per year across the fire area.

The Rim Fire, like almost all wildfires, burned in a mosaic pattern of high, moderate and low soil burn severity with some unburned areas within its perimeter. While the Rim Fire is the largest fire to ever occur on the Stanislaus National Forest, the soil burn severity was relatively low. The high soil burn severity is the second lowest of the principal fires within its perimeter that occurred since 1973. Of the 154,530 acres burned on NFS land, 7% (10,000 acres) resulted in high soil burn severity leaving very little ground cover (0 to 20%) distributed in various sized patches. Ground cover in the moderate soil burn severity areas was also substantially reduced as nearly all trees were killed by the fire. Post fire, cover exists on about 56% of the area (the total of the low soil burn severity and the unburned portion within the fire perimeter). This cover consists of living vegetation which primarily includes conifer trees with forest floor litter and duff, plus brush and smaller woody shrubs.

The Rim Fire burned through numerous watersheds which are an important component of the water supply, fish and wildlife habitat, recreation, timber production and other values of the Sierra Nevada. Portions of these watersheds previously burned in several fires during the last century, while some areas have not burned in over 100 years. About 98% of the Rim Fire burned within the Tuolumne River watershed. The remaining 2% burned in the North Fork Merced River watershed along the southern edge of the fire. The Rim Fire burned less severely near streams than in the uplands in almost all watersheds, and substantially less in many. And though it burned less in these locations there was still a notable loss of the stream shade capacity of conifers and riparian obligate trees and. While it may take conifers decades to return and once again provide shade, the riparian trees will fill the void in the short-term and also provide biodiversity along stream reaches burned in the Rim Fire.

Road density in the area ranges from one to six miles of road per square mile, with an average of about 4 miles, similar to other roaded areas of the forest. Road sediment discharge increases are expected as a result of the Rim Fire. Most increases are likely to occur in high soil burn severity areas, and to a lesser extent in moderate soil burn severity areas. Problems include locations of improper road drainage function and culvert issues at road-stream crossings. The undersized culverts cannot handle post-fire flow volume and the additional woody debris and sediment it carries.

Effects Analysis Process

Council on Environmental Quality (CEQ) NEPA regulations at 40 CFR 1502.25(a) directs “to the fullest extent possible, agencies shall prepare environmental impact statements concurrently with and integrated with …other environmental review laws and executive orders.” Each Chapter 3 resource section lists the applicable laws, regulations, policies and Executive Orders relevant to that resource. The resource reports (project record) include the surveys, analyses and findings required by those laws.

The “Affected Environment” within each Chapter 3 resource section describes the existing condition against which environmental effects were evaluated and from which progress toward the desired conditions can be measured.

The "Environmental Consequences" within each Chapter 3 resource section addresses the impacts of each alternative at the project scale (the scale of the proposed action as discussed in Chapter 1). However, the effects findings are based on site-specific analyses. Each resource specialist assessed each alternative at a level sufficient to support their effects analysis and identify any necessary site-specific mitigation. Most resources considered the short-term temporal analysis bounds to generally be the life of the active projects, about five to ten years. Beyond that time frame are the long-term effects. The resource reports (project record) contain additional details about the analysis process.

Environmental consequences form the scientific and analytical basis for comparison of alternatives, including the proposed action, through compliance with standards set forth in the Forest Plan. The environmental consequences discussion centers on direct, indirect and cumulative effects, along with applicable mitigation measures. Effects can be neutral, beneficial or adverse while the determination of significance is based on the context and intensity factors identified in the CEQ NEPA regulations (40 CFR 1508.27).

Direct and Indirect Effects

The analysis of direct and indirect effects disclosed in each Chapter 3 resource section is consistent with CEQ NEPA regulations (40 CFR 1508.8) which state:

- **Direct effects** are caused by the action and occur at the same time and place.
- **Indirect effects** are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.
- **Effects and impacts** are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.

Cumulative Effects

The analysis of cumulative effects disclosed in each Chapter 3 resource section is consistent with CEQ NEPA regulations (40 CFR 1508.7) which state:

- **Cumulative impact** is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Each Chapter 3 resource section describes the cumulative effects analysis area (all lands within the Rim Fire perimeter in most cases) and discloses the cumulative effects of each alternative. Appendix B (Cumulative Effects Analysis) provides more details related to the following discussion of past, present and reasonably foreseeable future actions potentially contributing to cumulative effects.

PAST ACTIONS

In order to understand the contribution of past actions to the cumulative effects of the alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that affected the environment and might contribute to cumulative effects. This cumulative effects analysis does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis for three reasons:

- First, a catalog and analysis of all past actions is impractical to compile and unduly costly to obtain. Innumerable actions over the last century (and beyond) impacted current conditions and trying to isolate the individual actions with residual impacts would be nearly impossible.
- Second, providing details of past actions on an individual basis would not be useful to predict the cumulative effects of the alternatives. In fact, focusing on individual actions would be less accurate than looking at existing conditions, because information on the impacts of individual past actions is limited and one cannot reasonably identify every action over the last century that contributed to current conditions. Focusing on impacts of past human actions risks ignoring the important residual effects of past natural events which may contribute to cumulative effects as much as human actions. Looking at current conditions captures all residual effects of past human actions and natural events, regardless of which particular action or event contributed to effects.
- Finally, the CEQ issued an interpretive memorandum on June 24, 2005 regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions" (CEQ 2005).

The cumulative effects analysis of past actions is consistent with Forest Service NEPA regulations (73 Federal Register 143, July 24, 2008; p. 43084-43099), which state, in part:

> "CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonable foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making. (40 CFR 1508.7)"

For those reasons, past actions are considered part of the existing condition described in the "Affected Environment" under each resource section in Chapter 3.

PRESENT ACTIONS

Present actions are those underway and currently affecting resources including: ongoing activities; Forest Service and other Federal land disturbance actions with completed NEPA decisions that are not yet fully implemented; and, private land disturbance actions.

Appendix B describes the present actions within the Rim Reforestation cumulative effects analysis area. Table B.01-1 lists the present disturbance actions on NFS lands.

REASONABLY FORESEEABLE FUTURE ACTIONS

Forest Service NEPA regulations define reasonably foreseeable future actions as: "Those Federal or non-Federal activities not yet undertaken, for which there are existing decisions, funding, or identified proposals" (36 CFR 220.3). The regulations go on to describe an "identified proposal" as a situation in which "[t]he Forest Service has a goal and is actively preparing to make a decision on one or more alternative means of accomplishing that goal and the effects can be meaningfully evaluated" [40 CFR 1508.23; 36 CFR 220.4(a)(1)]. In practice, an action becomes reasonably foreseeable and subject to meaningful evaluation when the agency has written a proposal and has circulated that proposal for public scoping (40 CFR 1501.7).

Appendix B describes the reasonably foreseeable future actions within the Rim Reforestation cumulative effects analysis area. Table B.01-2 lists the reasonably foreseeable future disturbance actions on NFS lands.

Forest Plan Direction

The Forest Service completed the Stanislaus National Forest Land and Resource Management Plan (Forest Plan) on October 28, 1991. The "Forest Plan Direction" (USDA 2010a) presents the current Forest Plan management direction, based on the original Forest Plan, as amended.

The Forest Plan identifies land allocations and management areas within the project area including: Wild and Scenic Rivers and Proposed Wild and Scenic Rivers; Critical Aquatic Refuge (CAR); Riparian Conservation Areas (RCAs); Near Natural; Scenic Corridor; Special Interest Areas; Wildland Urban Intermix; Protected Activity Centers (PACs); Old Forest Emphasis Areas; and, Developed Recreation Sites. The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Incomplete or Unavailable Information

CEQ NEPA regulations describe how Federal agencies must handle instances where information relevant to evaluating "reasonably foreseeable" [4] adverse impacts of the alternatives is incomplete or unavailable. According to 40 CFR 1502.22:

> When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking.
>
> a. If the incomplete information relevant to reasonably foreseeable significant adverse impacts is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the EIS.
>
> b. If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, the agency shall include within the EIS:
>
>   1. A statement that such information is incomplete or unavailable;
>   2. A statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment;
>   3. A summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment; and,
>   4. The agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community.

Chapter 3 identifies incomplete or unavailable information so the reader understands how they are addressed. The EIS summarizes existing credible scientific evidence relative to environmental effects and makes estimates of effects on theoretical approaches or research methods generally accepted in the scientific community.

[4] For the purposes of this rule, CEQ states: "reasonably foreseeable" includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason (40 CFR 1502.22).

Information on Other Resource Issues

The alternatives considered in detail do not affect the following resources or localized effects are disclosed under other resources; they are not further discussed in Chapter 3.

Climate Change

The following elements of global climate change are known with near certainty (IPCC 2014):

1. Human activities associated with economic and population growth are changing the composition of the Earth's atmosphere. Increasing levels of greenhouse gases, like carbon dioxide (CO2) in the atmosphere since pre-industrial times, are well-documented and understood.
2. The continued emission and atmospheric buildup of CO2 and other greenhouse gases is largely the result of human activities such as the burning of fossil fuels.
3. An "unequivocal" warming trend of about 1.0 degrees to 1.7 degrees Fahrenheit occurred from 1906-2005. Warming occurred in both the Northern and Southern Hemispheres and throughout the oceans. The amounts of snow and ice declined. The warmest 30-year period in the Northern Hemisphere over the past 1400 years was likely from 1983 to 2012.
4. The major greenhouse gases emitted by human activities remain in the atmosphere for periods ranging from decades to centuries. It is virtually certain that atmospheric concentrations of greenhouse gases will continue to rise over the next few decades.
5. Unprecedented increases in greenhouse gas concentrations are the dominant cause of a warming global climate.

The following are known climate trends derived from data collected over the last century and future climate predictions applicable to the Stanislaus National Forest (Meyer and Safford 2010):

1. Most of the Stanislaus National Forest experienced increases in temperature of 1.8 ºF or more over the last 75 years.
2. The occurrence of nighttime freezing temperatures decreased over the last century, likely contributing to trends of declining snowpack, snowpack longevity and snow water equivalents.
3. Precipitation across the Stanislaus National Forest varied over the last century.
4. The form of precipitation is likely changing from winter snowfall, persistent snowpack and snowpack melt to wetter winter snow, earlier snowpack ripening and runoff.
5. Summers are predicted to be drier than they are currently, regardless of annual precipitation.
6. There is broad consensus warming is predicted for California.
7. Wildfire activity, size and severity increased since the 1980s and this trend is expected to continue in the Sierra Nevada.

According to IPCC (2014), it is uncertain how much warming will occur, how fast that warming will occur, and how the warming will affect the rest of the climate system including precipitation patterns. Given what is known and what is not known about global climate change, the following discussion outlines the cumulative effects of this project on greenhouse gas emissions and the effects of climate change on forest resources.

Carbon Dioxide (CO2), Methane (CH4) and Nitrous Oxide (N20) emissions generated by project activities are expected to contribute to the global concentration of greenhouse gases that affect climate change. Projected climate change impacts include air temperature increases, sea level rise, changes in the timing, location, and quantity of precipitation, and increased frequency of extreme weather events such as heat waves, droughts, and floods. The intensity and severity of these effects are expected to vary regionally and even locally, making any discussion of potential site-specific effects of global climate change on forest resources speculative.

Because greenhouse gases from project activities mix readily into the global pool of greenhouse gases, it is not currently possible to discern the effects of this project from the effects of all other greenhouse gas sources worldwide, nor is it expected that attempting to do so would provide a practical or meaningful analysis of project effects. Potential regional and local variability in climate change effects add to the uncertainty regarding the actual intensity of this project's effects on global climate change. Further, emissions associated with this project are extremely small in the global atmospheric CO2 context, making it impossible to measure the incremental cumulative impact on global climate from emissions associated with this project.

In summary, the potential for cumulative effects is considered negligible for all alternatives because none of the alternatives would result in measurable direct and indirect effects on air quality, atmospheric greenhouse gas composition or global climatic patterns.

Inventoried Roadless Areas

The Forest Service Land Management Planning FSH 1909.12, Chapter 70 (Wilderness Evaluation) provides direction for inventory of all lands that may be suitable for inclusion in the National Wilderness Preservation System including areas identified in the Forest Service Roadless Area Conservation Final EIS (Volume 2, November 2000). It includes direction to comprehensively evaluate the wilderness characteristics (natural; undeveloped; outstanding opportunities for solitude or a primitive and unconfined type of recreation; special features; and, manageability) of each roadless area pursuant to criteria set forth in the Wilderness Act of 1964.

The Department of Agriculture, Forest Service adopted the Roadless Area Conservation Rule in 2001 with the purpose "to establish prohibitions on road construction, road reconstruction, and timber harvesting in inventoried roadless areas on National Forest System lands. The intent of this final rule is to provide lasting protection for inventoried roadless areas within the National Forest System in the context of multiple-use management." (66 Federal Register 9, January 12, 2001; p. 3244). As a result, the Agency established a national level rule for the management of roadless areas. Within this rule, the cutting, sale, or removal of trees must be clearly shown through project level analysis to contribute to the ecological objectives described in the Rule or under certain other circumstances. Such management activities are expected to be rare and to focus on small diameter trees. Thinning of small diameter trees, for example, that became established as the result of missed fire return intervals due to fire suppression and the condition of which greatly increases the likelihood of uncharacteristic wildfire effects would be permissible.

All or portions of three Inventoried Roadless Areas (IRAs) are located on NFS lands within the Rim Fire perimeter: 1) the Cherry Lake IRA (1,000 acres) in the east-central portion of the Forest adjacent to the Emigrant Wilderness and Yosemite National Park; 2) the North Mountain IRA (8,100 acres) in the southeast part of the Forest adjacent to Yosemite National Park; and, 3) the Tuolumne River IRA (17,300 acres) in the southwest part of the Forest containing the lower Clavey River and about 18 miles of the Tuolumne Wild and Scenic River (USDA 2014). The alternatives considered in detail do not include any activities within or adjacent to these IRAs. Nearby short-term project induced noise is consistent with the Roadless Area Characteristics[5] identified in the 2001 Roadless Rule. Therefore, the alternatives are not likely to result in direct, indirect or cumulative effects on those characteristics. The alternatives would have no perceivable impact on the existing manageability value of the

[5] Roadless Area characteristics are: high quality or undisturbed soil, water, and air; sources of public drinking water; diversity of plants and animal communities; habitat for threatened, endangered, proposed, candidate, and sensitive species, and for those species dependent on large, undisturbed areas of land; primitive, semi-primitive non-motorized and semi-primitive motorized classes of dispersed recreation; reference landscapes; natural appearing landscapes with high scenic quality; traditional cultural properties and sacred sites; and, other locally identified unique characteristics. (66 Federal Register 9, January 12, 2001; p. 3272).

roadless lands in the analysis area. No new permanent roads are proposed that would complicate potential Wilderness boundary management.

Transportation

The Stanislaus National Forest transportation system within the Rim Fire area is made up of 707.1 miles of National Forest System roads and 18.2 miles of National Forest System motorized trails (USDA 2014). Many of these roads and trails are designated as open to public motorized traffic, for access to particular destinations or for motorized recreation. The Forest Motor Vehicle Use Map and the Stanislaus National Forest Infra database display those designations. Many roads were improved during the timber sales to log trees burned in the Rim Fire.

No long-term changes to public motor vehicle use are proposed under this project. Previously designated routes documented on the Motor Vehicle Use Map will remain open following project implementation. Actions that may contribute to effects include: biomass removal and Forest Service administrative activities such as bringing in equipment to perform initial site preparation or fuels treatments.

Conditions: Forest transportation system conditions change with weather and use patterns. Many of the roads used to access this reforestation and noxious weed project were utilized during the recent salvage sales and the roads were improved at that time. Although no road work or infrastructure improvements are proposed in this project, ongoing routine maintenance is expected to occur. Surface deterioration proportionate to the traffic volume will occur on those main roads. This effect is expected to be minor and dispersed through location.

Traffic: During implementation, traffic will increase due to movement of equipment, forest products, contractor vehicles, and Forest Service personnel in and out of the project area. This effect is expected to be minor and dispersed through time and location.

Health and Safety: Although most roadside hazard trees were removed during implementation of the Rim Recovery and Rim HT projects, additional trees may die and create a hazard along NFS roads. Cutting of hazard trees is a Forest administrative activity that would occur as needed.

In summary, the potential for cumulative effects is considered negligible for all alternatives because none of the alternatives would result in measurable direct and indirect effects on transportation resources.

Yosemite National Park

The Stanislaus National Forest shares a common boundary, much of which is Wilderness, with Yosemite National Park to the east. The National Park Service manages park resources and values to leave them unimpaired for the enjoyment of future generations. The alternatives considered in detail will not directly affect park resources. Action alternatives will increase worker and public safety and improve Forest Service ability to manage future fires, which may indirectly benefit park resources and values. Wildlife habitat improvement activities may benefit Yosemite National Park wildlife populations by providing corridors for wildlife movement on the Stanislaus National Forest.

NEPA and CEQA Compliance

NEPA requires agencies to assess the environmental effects of a proposed agency action and any reasonable alternatives before making a decision on whether, and if so, how to proceed. The California Environmental Quality Act (CEQA) applies to projects of all California state, regional or local agencies, but not to Federal agencies. Its purposes are similar to NEPA. They include ensuring informed governmental decisions, identifying ways to avoid or reduce environmental damage through feasible mitigation or project alternatives, and providing for public disclosure (CEQA Guidelines, 15002, subd. (a)(1)(4)).

The CEQ regulations for implementing NEPA encourage cooperation with state and local agencies in an effort to reduce duplication in the NEPA process (40 CFR 1506.2). The CEQ regulations further provide agencies with the ability to combine documents, by stating that "any environmental document in compliance with NEPA may be combined with any other agency document to reduce duplication and paperwork" (40 CFR 1506.4). Furthermore, if an existing document cannot be utilized, portions may be incorporated by reference. Like NEPA, CEQA encourages cooperation with Federal agencies to reduce duplication in the CEQA process. In fact, CEQA recommends that lead agencies rely on a Federal EIS "whenever possible," so long as the EIS satisfies the requirements of CEQA (Cal. Pub. Resources Code, 21083.7).

Overall, the resource analysis contained in this EIS meets CEQA requirements; however, the following information is provided since this document uses terminology not commonly used in CEQA and vice versa:

- **Management Requirements**: Chapter 2 lists management requirements. The action alternatives include management requirements designed to implement the Forest Plan and to minimize or avoid potential adverse impacts. Each action alternative lists the management requirements specific to it and Chapter 2.03 identifies those common to all action alternatives. Management requirements are mandatory components of each alternative and will be implemented as part of the proposed activities.
- **Green House Gas Emissions**: Chapter 3.01 (Climate Change) and Chapter 3.02 (Air Quality) describe and evaluate greenhouse gas emissions.
- **Growth Inducing Impacts and Energy Impacts**: Chapter 3.10 (Society, Culture and Economy) describes population growth and evaluates economic growth inducing impacts. No population growth inducing impacts are expected since NFS lands are not available for urbanization.

Resource Reports

The resource sections in this Chapter provide a summary of these project-specific reports and other documents (project record); they are available by request and are incorporated by reference.

- **Aquatic Species**: Biological Assessment for Threatened and Endangered Species for Aquatic Species and Terrestrial Wildlife for US Fish and Wildlife Service review of proposed action (see wildlife); Aquatic Biological Assessment and Biological Evaluation (Aquatic BA and BE); Aquatic Management Indicator Species Report (Aquatic MIS Report); and, Fisheries Report.
- **Cultural Resources**: Cultural Resources Report
- **Fire and Fuels**: Fuels Report including Air Quality (Fuels Report)
- **Invasive Species**: Noxious Weed Risk Assessment (NWRA)
- **Range**: Rangeland Specialist Report (Range Report)
- **Recreation**: Recreation Report
- **Sensitive Plants**: Botanical Resources Report (Botany Report); and, Biological Evaluation for Sensitive Plants (Sensitive Plants BE)
- **Soils**: Soils Report
- **Vegetation**: Forest Vegetation Report (Vegetation Report)
- **Visual**: Visual Resource Specialist Report (Visual Report)
- **Watershed**: Watershed Management Report including cumulative watershed effects (Watershed Report); Watershed Monitoring Plan; and, Erosion Control Plan
- **Wildlife**: Terrestrial Biological Assessment, Biological Evaluation and Wildlife Report (Terrestrial BE); Terrestrial Wildlife Management Indicator Species Report (Wildlife MIS Report); and, Migratory Landbird Conservation Report

3.02 AIR QUALITY

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

The **Federal Clean Air Act** (CAA) of 1963, as amended in 1990, is the basis for national control of air pollution. The CAA was designed to “protect and enhance” the quality of the nation’s air resources. Basic elements of the CAA include national ambient air quality standards (NAAQS) for criteria air pollutants, technology based emission control standards for hazardous air pollutants, state attainment plans, a comprehensive approach to reducing motor vehicle emissions, control standards and permit requirements for stationary air pollution sources, acid rain control measures, stratospheric ozone protection, and enforcement provisions.

The **California Clean Air Act** of 1988 provides the basis for air quality planning and regulation in California independent of federal regulations and establishes ambient air quality standards for the same criteria pollutants as the federal clean air legislation. Under the federal CAA, States can adopt air quality standards that are more stringent than the federal NAAQS. California adopted standards for criteria pollutants that are generally more restrictive than the federal standards. The California Air Resources Board (CARB) is the agency responsible for establishing California ambient air quality standards (CAAQS).

The Calaveras, Tuolumne and Mariposa County **Air Pollution Control Districts** (APCD) are responsible for implementing and regulating air quality programs in the Stanislaus National Forest.

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Air Quality Management Practices

Smoke from prescribed fire is managed so that emissions meet applicable state and federal standards. Prescribed fires are regulated and authorized by the local Air Pollution Control District (APCD) and the California Air Resources Board (CARB) under the process established by the California Smoke Management Program (Title 17). The legal basis of the program is found in the Smoke Management Guidelines for Agricultural and Prescribed Burning adopted by the CARB on March 23, 2001 (CARB 2001). The Guidelines provide the framework for State and local air district regulators to conduct the program. Elements of the program include:

- Registering and Permitting of Agricultural and Prescribed Burns
- Meteorological and Smoke Management Forecasting
- Daily Burn Authorization
- Enforcement

The 1990 Clean Air Act (CAA) amendments and the 1998 EPA Interim Policy on Wildland and Prescribed Fire form the federal requirements and guidance behind the California program (Ahuja et al. 2006). Burn days are allocated by the responsible air quality regulatory agency when dispersion conditions are most likely to prevent exposure to unhealthy smoke concentrations. Allocations are considered on a cumulative potential for the air basin by regulatory review of a unified reporting system, the Prescribed Fire Information Reporting System (PFIRS), maintained by the CARB (CARB 2012). The reporting system and a daily conference call between regulatory meteorologists, resource agency meteorologists, and resource agency fire managers allow for a daily discussion of ongoing events, smoke dispersion, allocations, and burn approval outlook. The objective of this system is to facilitate fuel treatment and minimize smoke exposure to the public.

In the spring of 2011, staff of the CARB, Federal and State Land Management Agencies, and Air Districts in California worked together to revise the policy that governs the management of naturally ignited fires. The protocol, entitled "Coordination and Communication Protocol for Naturally Ignited Fires" (CARB 2011), establishes a framework from which smoke and emission impacts from wildfires would be minimized through fire suppression techniques and improved public awareness.

- The Forest Service utilizes Best Available Control Measures (BACMs) and Best Smoke Management Practices (BSMPS) to reduce particulate emissions (NRCS 2011). BACMs are a combination of practices intended to reduce emissions to the lowest practicable amount. BACMs are accomplished by diluting or dispersing emissions, or by preventing potential emission sources whenever possible. Examples of BACMs include: Reducing pollutants by limiting the mass of material burned, burning under moist fuel conditions when broadcast burning, shortening the smoldering combustion period, and increasing combustion efficiency by encouraging the flaming stage of fire when burning piles.
- Diluting pollutant concentrations over time by reducing the rate of release of emissions per unit area, burning during optimum conditions, and coordinating daily and seasonally with other burning permittees in the area to prevent standard exceedances.

Effects Analysis Methodology

Smoke emissions were calculated for machine pile burning, jackpot burning, understory burning and wildfires. Greenhouse gas emissions were calculated.

Assumptions Specific to Air Quality

- Emissions were calculated using the formula [**E**$_i$ (tons) equals (**A** multiplied by **FL** multiplied by **percent C** multiplied by **EF**$_i$) all divided by 2000 to convert pounds to tons]; where:
  - **E**$_i$ equals Emissions in tons for the emission type (e.g. $PM_{2.5}$ or NOx or CH_4);
  - **A** equals Area in acres;
  - **FL** equals Fuel Loading in tons per acre;
  - **percent C** equals percent fuel consumed; and,
  - **EF**$_i$ equals Emission factor for the type (in pounds per ton of dry fuel consumed).
- Percent combustion under pile burning is 100%.
- Percent combustion under jackpot burning is 50%.
- Percent combustion with understory burn is 50%.
- Jackpot burns are similar to understory burns.
- EFs for pile, understory burns and jackpot burns were derived from Hardy et al. 2001: PM_{10} equals (12.4, 25), $PM_{2.5}$ equals (10.8, 22), CH_4 equals (11.4, 8.2), NMHC equals (8, 6.4), CO equals (153, 178), CO_2 equals (3271, 3202), NO_x equals (6, 6), SO_x equals (2.4, .2.4).
- GWP (Global Warming Potential) factor for greenhouse gas conversion to CO_2 equivalent metric tons from IPCC 2007.
- Wildfire emissions were based on a wildfire burning under 90th percentile weather conditions at year 20 for all scenarios.

Data Sources

- First Order Fire Effects Monitoring Program
- CARB (2010)
- EPA (2012)
- Inciweb (2013)
- IPCC (2007)
- Placer County Air Pollution Control District (2008) and Executive Office et al. (2008)
- Springsteen et al. (2011)
- Tarnay (2014)

Air Quality Indicators

The Clean Air Act lists 189 hazardous air pollutants to be regulated. Some components of smoke, such as polycyclic aromatic hydrocarbons (PAH) are known to be carcinogenic. Probably the most carcinogenic component is benzo(a)pyrene (BaP). Other components, such as aldehydes, are acute irritants. In 1994 and 1997, 18 air toxins were assessed relative to the exposure of humans to smoke from prescribed and wildfires. The following seven pollutants are most commonly found in smoke from fire:

- **Particulate Matter** ($PM_{2.5}$ and PM_{10} a criteria pollutant): Particulates are the most prevalent air pollutant from fires and are of the most concern to regulators. Research indicates a correlation between hospitalizations for respiratory problems and high concentrations of fine particulates. $PM_{2.5}$ are fine particles that are 2.5 microns in diameter or less in size. PM_{10} are fine particles that are between 10 and 2.5 microns in diameter or less in size. Particulates can include carcinogens and other toxic compounds. Overexposure to particulates can cause irritation of mucous membranes, decreased lung capacity and impaired lung function.
- **Methane** (CH_4): Methane is an odorless, colorless flammable gas. Short-term exposure to methane may result in feeling tired, dizziness and headache. No long-term health effects are currently associated with exposure to methane. Methane is a greenhouse gas (GHG) and contributes to global climate warming (IPCC 2007).
- **Carbon Monoxide** (CO a criteria pollutant): Carbon monoxide reduces the oxygen carrying capacity of the blood, a reversible effect. Low exposures can cause loss of time awareness, motor skills and mental acuity. Also, exposure can lead to heart attacks, especially for persons with heart disease. High exposures can lead to death due to lack of oxygen.
- **Carbon Dioxide** (CO_2): Carbon dioxide is a colorless, odorless and non-poisonous gas formed by combustion of carbon and in the respiration of living organisms. Carbon dioxide is the primary GHG emitted through human activities. Greenhouse gases act like a blanket around the Earth, trapping energy in the atmosphere and causing it to warm. The buildup of GHGs can change the Earth's climate and result in dangerous effects to human health and welfare and to ecosystems (IPCC 2007).
- **Nitrogen Oxide** (NO_x a precursor to O_3): Nitrogen oxide is a group of different gases made up of different levels of oxygen and nitrogen. Nitrogen dioxide (NO_2 a criteria pollutant) is a reddish-brown gas. Small levels can cause nausea, irritated eyes and/or nose, fluid forming in lungs and shortness of breath. Breathing in high levels can lead to rapid, burning spasms, swelling of throat, reduced oxygen intake, a larger buildup of fluids in lungs and/or death. N_2O is a GHG and contributes to global warming.
- **Ozone** (O_3 a criteria pollutant) is the most widespread air quality problem in the state according to the CARB (2010). It is not emitted directly but is formed from reactions of hydrocarbons and NO_x in the presence of sunlight. It can cause reduced lung function and irritated eyes, nose and throat. It is known to cause damage to some vegetation, including ponderosa pine and Jeffrey pine trees (Procter et al. 2003).
- **Sulfur Oxide** (SO_x a criteria pollutant): Short-term exposure to high enough levels of sulfur dioxide (SO_2) can be life threatening. Generally, exposures to SO_2 cause a burning sensation in the nose and throat. SO_2 exposure can cause difficulty breathing, including changes in the body’s ability to take a breath or breathe deeply, or take in as much air per breath. Long-term exposure to sulfur dioxide can cause changes in lung function and aggravate existing heart disease. Asthmatics may be sensitive to changes in respiratory effects due to SO_2 exposure at low concentrations. Sulfur dioxide is not classified as a human carcinogen (it has not been shown to cause cancer in humans). SO_x is not an issue in the state and has not been analyzed.

The Rim Reforestation project area is located in Tuolumne County and Mariposa County, California. The direct, indirect and cumulative effects analysis area for the air quality section of this report is the Tuolumne and Mariposa APCDs located in the Mountain Counties Air Basin.

Affected Environment

Existing Conditions

According to the EPA Green Book, updated January 30, 2015, Tuolumne and Mariposa counties are Designated Non-Attainment Areas for ozone; the project area falls within these two counties. The Emigrant Wilderness and Yosemite National Park are Federal Class 1 areas adjacent to the project area. The San Joaquin Valley, a non-attainment area, runs along the western boundary of the project area. The Forest Service follows the guidelines assigned by the CARB [ozone State Implementation Plan (SIP), visibility SIPs, and Title 17] to limit state-wide exposure on a cumulative basis, in compliance with the Clean Air Act (CARB 2001; 2008).

Air quality from the Rim Fire reached unhealthy levels from Yosemite to the San Joaquin Valley, according to an alert from the National Weather Service. People were advised to avoid strenuous outdoor activity or to remain indoors because fine particles in smoke can irritate the eyes and respiratory system and aggravate chronic heart and lung disease. Figure 3.02-1 shows the smoke from the Rim Fire in the Groveland area and how people responded by wearing filtering devices.

Figure 3.02-1 Smoke from the Rim Fire billows over Groveland and affects air quality

Environmental Consequences

Effects Common to all Alternatives

Implementation of the initial site preparation activities of either pile burning or understory/jackpot burning depends on seasonal climate conditions and budget. Emissions comparisons are based on understory/jackpot burning which produce the highest emissions of analyzed prescribed fire treatments. Although understory/jackpot burning have the highest prescribed fire emissions, they are still lower than wildfire emissions as shown in the tables below. Emissions for all the alternatives including Alternative 2 (the no action alternative serves as the control) are shown the following tables grouped by treatments: Prescribed Fire in Table 3.02-1; Wildfires in Table 3.02-2; and, Greenhouse Gases in Table 3.02-3 and Table 3.02-4.

DIRECT AND INDIRECT EFFECTS

Prescribed Fires

Table 3.02-1 displays emissions for understory/jackpot burning. Burning would be completed under approved burn and smoke management plans. Given the ability to control ignition times to favor good smoke dispersion, it is not anticipated that prescribed burning would impact the local communities. Smoke would be transported to the northeast by typically southwest winds during the day. At night, some smoke from smoldering burns in the project area may move down drainages. Piles would be burned under weather conditions that would allow efficient combustion.

Table 3.02-1 Alternatives 1, 2, 3, 4 and 5: Emissions under understory and jackpot burning (tons)

Emissions (tons)	**Alternative 1** (16,696 acres)	**Alternative 2** (0 acres)	**Alternative 3** (16,696 acres)	**Alternative 4** (19,362 acres)	**Alternative 5** (16,696 acres)
PM_{10}	3,131	0	3,131	4,175	3,131
$PM_{2.5}$	2,755	0	2,755	3,674	2,755
CH_4	1,027	0	1,027	1,369	1,027
NMHC	801	0	801	1,069	801
CO	22,289	0	22,289	29,726	22,289
CO_2	400,954	0	400,954	534,725	400,954
NO_x	751	0	751	1,002	751
Totals	**431,708**	**0**	**431,708**	**575,740**	**431,708**

Generally, $PM_{2.5}$ emissions are the dominant public health risk and can be viewed as the primary indicator. The total treatment acres and emissions displayed have value as a relative comparison of alternatives but not as an assessment of public exposure since the fuel treatments will take place over multiple years and multiple times during each year. Public exposure of smoke emissions will be mitigated by the daily burn day permission and allocation from the California Air Resources Board and the local air pollution control districts. The objective of this program is to mitigate public exposure below health risk thresholds. Most likely the total emissions occurring on any particular burn day may not be allowed to exceed 100 to 200 tons of $PM_{2.5}$ irrespective of the action alternative.

Wildfires

Emissions from wildfires within the project area were modeled. Table 3.02-2 is based on the First Order Fire Effects Model (FOFEM 6.0), the 90th percentile weather for the project area and the estimated fuel loading under each Alternative at year 20 (Boucher 2014). For Alternative 2, the 19,362 acres identified in Alternative 4 were used for the smoke emission analysis. Alternative 2 generates the maximum emissions compared to all other alternatives. This demonstrates the emissions savings that can be generated from prescribed burn treatments as opposed to wildfire scenarios.

Table 3.02-2 Alternatives 1, 2, 3, 4 and 5: Smoke Emissions at Year 20 (Wildfire Conditions, tons)

Emissions (tons)	**Alternative 1** (16,696 acres)	**Alternative 2** (19,362 acres)	**Alternative 3** (16,696 acres)	**Alternative 4** (19,362 acres)	**Alternative 5** (16,696 acres)
PM_{10}	3,757	10,020	3,757	5,010	3,757
$PM_{2.5}$	3,306	8,817	3,306	4,409	3,306
CH_4	1,232	3,287	1,232	1,643	1,232
NMHC	962	2,565	962	1,283	962
CO	26,747	71,341	26,747	35,671	26,747
CO_2	481,145	1,283,340	481,145	641,670	481,145
NO_x	902	2,405	902	1,202	902
Totals	**518,051**	**1,381,775**	**518,051**	**690,888**	**518,051**

Table 3.02-3 displays the GHG produced from understory burning and jackpot burning. There are no GHGs generated under Alternative 2 because no jackpot or pile burning occurs.

Table 3.02-3 Alternatives 1, 2, 3, 4 and 5: Greenhouse Gas Emissions (Prescribed Burning)

CO_2 Equivalent (metric tons)	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3	Alternative 4	Alternative 5
CH_4	1,027	0	1,027	1,369	1,027
CO_2	400,954	0	400,954	534,725	400,954
N_2O	751	0	751	1,002	751
Totals	**402,732**	**0**	**402,732**	**537,096**	**402,732**

Table 3.02-4 displays the GHG produced by wildfires for all alternatives.

Table 3.02-4 Alternatives 1, 2, 3, 4 and 5: Greenhouse Gas Emissions (Wildfire Conditions)

CO_2 Equivalent (metric tons)	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3	Alternative 4	Alternative 5
CH_4	1,232	3,287	1,232	1,643	1,232
CO_2	481,145	1,283,340	481,145	641,670	481,145
N_2O	902	2,405	902	1,202	902
Totals	**483,279**	**1,289,032**	**483,279**	**644,515**	**483,279**

CUMULATIVE EFFECTS

Additional projects within and adjacent to the project area utilizing prescribed burning include: Rim Recovery, Two-mile Ecological Restoration: Vegetation Management, Soldier Creek Timber Sale, Reynolds Creek Ecological Restoration and several thousand acres of pile burning on private land. California's Smoke Management Program (Title 17) is designed to prevent cumulative effects from prescribed fire operations. The program provides allocations of emissions based on the airshed capacity and forecasted dispersal characteristics. The allocation process considers all burn requests, meteorological conditions, forecasted air pollution levels (similar to the BSMPs described by the NRCS 2011) and uncontrollable events like wildfire. Wildfire emissions can overwhelm air basins and most prescribed burn requests are denied during wildfire events. As a result of the California Smoke Management Program and agency oversight, none of the action alternatives are expected to contribute toward air quality cumulative effects.

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

The wildfire emissions for $PM_{2.5}$ and other pollutants are lower under Alternative 1 as compared to Alternative 2. The total GHGs produced are 402,732 CO_2 equivalent metric tons from prescribed fire treatments.

CUMULATIVE EFFECTS

Cumulative Effects would be similar as described under Effects Common to all Alternatives

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

Alternative 2 does not treat any acres and therefore no emissions are displayed for understory and jackpot burning. Under Alternative 2, no pile burning, understory burning or jackpot burning occur; therefore, smoke would not be directly generated from management activities. Lightning and human caused ignitions are expected to continue within the perimeter of the Rim Fire. Table 3.02-2 shows that under a wildfire scenario during 90th percentile weather conditions at year 20, $PM_{2.5}$ emissions for Alternative 2 would be 8,817 tons as compared to 3,306 tons under Alternative 1.

Although Alternative 2 would not produce GHGs tied to the management actions defined in the other alternatives it would likely produce the highest level of GHGs as a result of wildfires. The 2013 Rim Fire consumed about 257,000 acres and produced 11 million tons of GHGs as CO_2 equivalent metric tons (Tarnay 2014). Table 3.02-4 shows about 1.3 million tons of GHG would be produced from 19,362 wildfire acres under Alternative 2.

Where wildfires cannot be contained and they burn into heavy fuels, it is expected that heavy smoke from fire burning or smoldering in downed logs would result. This smoke would be blown to the northeast towards Yosemite National Park, a Federal Class 1 area, by typical southwest winds during the day. At night, smoke from a fire in this area would move down the drainages and likely cause impacts to the San Joaquin Valley.

CUMULATIVE EFFECTS

The cumulative effects from other projects would be the same as described under Effects Common to all Alternatives. However, when the effects from Alternative 2 are added, the cumulative effects are also much higher than the action alternatives.

Alternative 3

DIRECT AND INDIRECT EFFECTS

Same as Alternative 1.

CUMULATIVE EFFECTS

Same as Alternative 1.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Alternative 4 includes the highest amount of prescribed burning. Alternative 4 reintroduces fire to the landscape, but does not reduce the existing fuel loading as much as the other action alternatives. Under this Alternative, treatment emissions will be higher than Alternatives 1, 3 and 5. Alternative 4 will create the most emissions under a wildfire when compared to all other action alternatives. The wildfire emissions for $PM_{2.5}$ and other pollutants are lower under Alternative 4 as compared to Alternative 2. The total GHGs produced are 537,096 CO_2 equivalent metric tons from prescribed fire treatments.

CUMULATIVE EFFECTS

Cumulative effects would be similar as described under Effects Common to all Alternatives.

Alternative 5

DIRECT AND INDIRECT EFFECTS

Same as Alternative 1.

CUMULATIVE EFFECTS

Same as Alternative 1.

Summary of Effects Analysis across All Alternatives

Table 3.02-1 displays total emissions for understory and jackpot burning for each alternative. Total emissions from wildfires were generated using the 90th percentile weather, fuel loading at year 20 and multiplied by the number of acres treated for each alternative except Alternative 2. For Alternative 2, the 19,362 acres identified in Alternative 4 were used for the smoke emission analysis. Areas outside treatment units would experience similar fire behavior, which would result in similar emissions. The expected amount of smoke emissions under wildfire conditions outside of areas previously treated to meet desired fuel loading at year 20 would be 2.6 times more for all types of emissions, as shown in Table 3.02-2.

The project is located in an area designated as non-attainment for ozone. Ozone is known to impact human respiratory function and the health and vigor of some vegetation including ponderosa and Jeffry pine (Procter et al, 2003). The burn treatments under Alternatives 1, 3, 4 and 5 will be conducted under an EPA approved California Smoke Management Program (SMP). Under the revised Conformity Rules the EPA has included a Presumption of Conformity for prescribed fires that are conducted in compliance with a SMP; therefore, the federal actions will be presumed to conform and no separate conformity determination will be made. The California Smoke Management Program provides for the allocation of emissions from biomass burning with respect to cumulative effects. Biomass burning projects are regulated and coordinated by air quality regulatory jurisdictions and all entities submitting burns for approval. In making those decisions, air quality regulators consider forecasts, dispersion conditions, locations of proposed projects and background air quality by air basin. These considerations have historical success in preventing cumulative effects of smoke.

3.03 Aquatic Species

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

The Endangered Species Act of 1973 (16 USC 1531 et seq.) requires that any action authorized by a federal agency not be likely to jeopardize the continued existence of a TE species, or result in the destruction or adverse modification of habitat of such species that is determined to be critical. Section 7 of the ESA, as amended, requires the responsible federal agency to consult the United States Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service concerning TE species under their jurisdiction. It is Forest Service policy to analyze impacts to TE species to ensure management activities are not be likely to jeopardize the continued existence of a TE species, or result in the destruction or adverse modification of habitat of such species that is determined to be critical. This assessment is documented in a Biological Assessment (BA) and is summarized and referenced in this Chapter.

USDA Departmental Regulation 9500-004 provides the following direction to USDA agencies.

Regional Forester Sensitive Species

1. Assure that the values of fish and wildlife are recognized, and that their habitats, both terrestrial and aquatic, including wetlands, are recognized and enhanced where possible as the Department carries out its overall missions.
2. Consider fish and wildlife and their habitats in developing programs for these lands. Alternatives that maintain or enhance fish and wildlife habitat should be promoted. When compatible with objectives for the area, management alternatives that improve habitat will be selected.
3. Balance the competing uses for habitat supporting fish and wildlife through strong, clear policies, relevant programs, and effective actions to sustain and enhance fish and wildlife in desired locations and numbers.
4. Recognize that fish and wildlife have inherent values as components and indicators of healthy ecosystems, and that they often demonstrate how altered environments may affect changes in quality of life for humans.
5. Avoid actions “which may cause a species to become threatened or endangered”.

Threatened, Endangered, Candidate and Proposed Species

1. Conduct activities and programs “to assist in the identification and recovery of threatened and endangered plant and animal species.”
2. Avoid actions “which may cause a species to become threatened or endangered.”
3. Consult “as necessary with the Departments of the Interior and/or Commerce on activities that may affect threatened and endangered species.”
4. Not “approve, fund or take any action that is likely to jeopardize the continued existence of threatened and endangered species or destroy any habitat necessary for their conservation unless exemption is granted pursuant to subsection 7(h) of the Endangered Species Act of 1973, as amended.”

Threatened and Endangered species are those Federally listed by the USFWS; Candidate species are candidates to become Proposed species but issuance of a proposed rule is currently precluded by higher priority listing actions (USFWS 1998). Sensitive species are those designated by the Regional Forester with the goal of proactively developing and implementing management practices to ensure that those species do not become Threatened or Endangered, and therefore require protection under the Endangered Species Act because of Forest Service actions (Departmental Regulation 9500-004).

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

This chapter serves as a summary of the analysis for aquatic species that may be affected by the project. Additional analysis will be provided in the Biological Assessment and Evaluation.

Project effects analyses covered threatened, endangered and proposed species where their geographic and elevation range and suitable habitat occurred within the Rim Reforestation project area. An official list of federal threatened, endangered and proposed species covering the project area was obtained from the Sacramento U.S. Fish and Wildlife Office website on December 5, 2013, and updated on April 17, 2014 (Document 140417112513); USFWS IPaC website checked November 2015 to confirm species status. The Sierra Nevada yellow-legged frog status was changed to “Endangered” on June 30, 2014. Scientific literature, state and federal databases (CNDDB, Aquasurv) were also examined to determine if species may occur in the project area.

Assumptions Specific to Aquatic Species

- The map developed by Dr. Roland Knapp provides the best available estimate of the former range of the Sierra Nevada yellow-legged frog (SNYLF). The map was developed using a Maxent model and using every verified historical and current SNYLF locality. This model was also used by the U. S. Fish and Wildlife Service to refine the boundaries of proposed critical habitat for the frog (USFWS 2013b).
- For the foothill yellow-legged frog (FYLF) and western pond turtle (WPT), all intermittent and perennial streams below 4,200 feet in elevation provided suitable habitat for the species. This is considered a conservative approach because some intermittent streams do not provide any perennial water, making occupancy by either species unlikely. If these small, intermittent tributaries have very steep pitches (e.g., 20-foot high waterfall), they are also unlikely to be used by the turtle (Holland 1994). Also, the WPT may also occupy streams above the 4,200 foot elevation because one known occupied site above this elevation, but almost all occupied sites are lower than 3,000 feet in elevation. Two occupied sites (ponds) are at 5,400 feet within this project area with no clear indication of how they became occupied by the species. It is possible that they occur at these sites naturally or are an artefact of introduction by humans.
- All suitable habitats are assumed to be occupied by the species because of the limitations inherent in visual encounter surveys. Since the FYLF can remain hidden in streamside vegetation, roots, or cracks in rocks and WPT detect and hide quickly from surveyors (at long distances), the lack of detection during a single survey does not indicate unoccupied habitat. Also, some surveys only cover portions of a stream which limits an assumption of occupancy for an entire stream.
- A 300-meter (984 feet) analysis buffer was used for the WPT around suitable aquatic habitats to account for upland habitat use. This buffer is assumed to include a large majority of the upland habitat use, but acknowledges that turtles sometimes move distances greater than 300 meters from the water. Note: This is not an exclusion buffer, treatment would occur within 300 meters of aquatic habitat.
- In the post-fire environment, most of the sediment from hillslope erosion is assumed to end up in a stream. This assumption is more valid for high soil burn severity areas on steep slopes that are close to streams. High-severity areas typically have no beneficial ground cover and have water-repellent layers that allow sediment to be eroded. Roughness in topography, downed wood, rocks and stump holes all have the potential to trap sediment being transported downslope and the assumption of 100% sediment routing to stream channels is an overestimation. However, using

this assumption allows for the comparison of erosion rates and sedimentation across all alternatives.

- Changes in sediment from project-related activity at the 5th Level Hydrologic Unit Code (HUC) watershed scale are assumed to be relatively minor when compared to post-fire and salvage logging sedimentation. For example, the amount of post-fire sediment delivered to the Clavey River may have small, localized consequences, but at the point of confluence with the Tuolumne, there would be too little sediment to significantly impair biological functions. Further, there would be very little detectable change in suitability for most aquatic habitats when the total amount of project-related sediment is added to the post-fire sediment. This is because large bedrock rivers are very effective at storing and transporting fine sediments.
- Species are not present where suitable habitat is not present.
- Proposed water quality BMPs and management requirements would function as designed and reduce the risk of both direct and indirect effects to aquatic species.
- At a minimum, herbicide use near aquatic habitat would be defined by product labels; in most cases, additional management requirements would increase buffer width.
- Multiple entries would be required for most units. The analysis timeframe is 10 years, and assumes that multiple treatments would occur within each unit over this period of time. Analysis assumes the vast majority of effects (e.g., sediment increase) from each treatment would have subsided before the same area is treated again (no additive effects). It is recognized that vegetation cover/structure would not fully recover over the short-term. After 5 years, heavy equipment use is not proposed; therefore project-related sediment increase (about 5 years) from actions such as herbicide use and hand grubbing are expected to be markedly less.

Data Sources

- Stanislaus National Forest basemap, watersheds delineated at multiple scales (Hydrologic Unit Codes 5-8), stream gradient layer.
- Stanislaus National Forest aquatic survey database (Aquasurv).
- Stanislaus Streamscape Survey Inventory (SSI) database.
- California Wildlife Habitat Relationships System (CWHR) and the California Natural Diversity Database.
- Sediment analysis (3.11 Soils and 3.15 Watershed).
- Watershed, soils and geology BAER reports.

Aquatic Species Indicators

THREATENED AND ENDANGERED SPECIES

The Aquatic BA and BE, evaluate two federally listed species: the threatened California red-legged frog (CRLF) and endangered Sierra Nevada yellow-legged frog (SNYLF). The indicators used for the analysis of potential impacts to these aquatic species are related to habitat suitability, breeding habitat and upland habitat.

Breeding and Non-breeding Aquatic Habitat

- Amount of breeding habitat affected by project activities (CRLF)
- Amount of non-breeding habitat affected by project activities (CRLF and SNYLF)

Habitat Suitability (CRLF and SNYLF)

- Acres of vegetation change due to all project activities within species-specific terrestrial habitat buffers.

SENSITIVE SPECIES

The Aquatic BE evaluates three Forest Service sensitive species: foothill yellow-legged frog (FYLF), western pond turtle (WPT) and hardhead. The indicators used for the analysis of potential impacts to these aquatic species include indicators common to all three species and indicators specific to each species.

Common Indicators

- Amount of species-specific buffer affected by the activities in each alternative.
- Proportion of available habitat potentially impacted by project activities.

Species Specific Indicators

- Percentage of foothill yellow-legged frog buffer (in acres) affected by project activities.
- Percentage of western pond turtle buffer (in acres) affected by project activities.

Aquatic Species Methodology by Action

THREATENED AND ENDANGERED SPECIES

The methodology used in the analysis for the CLRF and the SNYLF were similar. Within the project area, occupancy and habitat suitability assessments identified localized analysis areas for each species. These analysis areas were defined by suitable breeding habitats and the non-breeding, upland and dispersal habitats associated with them. Within each discrete analysis area, effects to individuals and effects to habitats were analyzed for each alternative.

California Red-legged Frog

Perennial and intermittent aquatic habitats at elevations of 4,000 feet or less (historic localities above this elevation are not expected to be affected by project actions) were assessed for CRLF breeding and non-breeding suitability based on the primary constituent elements (PCEs) as defined by the USFWS (USFWS 2010). The direct, indirect and cumulative effects for CRLF were based on suitable breeding habitats within one mile of the project area boundaries. The remaining habitat components (non-breeding aquatic, upland and dispersal) were then identified within one mile of the breeding habitats.

Sierra Nevada Yellow-legged Frog

A range map developed by Dr. Roland Knapp using historically and currently occupied sites was used as the basis for identifying suitable habitat for the SNYLF. Streams and ponds within the area covered by the range map were considered for analysis. The direct, indirect and cumulative effects were conducted for SNLYF suitable breeding, non-breeding and upland habitats where project activities were proposed within 984 feet of ponds and within 82 feet of any portion of a stream habitat as determined by the defined extent of the upland area for each of these habitats (USFWS 2013b).

Existing Condition

Known pre-fire habitat characteristics were gathered and summarized to establish a baseline to compare how the estimated effects of the Rim Fire could affect each habitat. Most of the suitable breeding habitats included in this analysis had some level of pre-fire existing condition information. In many areas, substantial post-fire vegetation growth (predominantly brush species) has occurred.

Pre-fire existing condition assessments utilized a variety of factors. For the CRLF, the primary factors considered included, bullfrog presence, water depth and other human caused disturbances (recreation, roads and developed areas). The primary factors contributing to SNYLF pre-fire existing condition assessments included fish presence, depth and gradient and pool presence. These pre-fire existing condition factors were used in addition to the PCEs as defined by the (USFWS 2013b).

Sediment Analysis

The project watershed report provides data on expected sediment input from both natural sources and project actions. Sediment is discussed qualitatively and comparatively in this report.

Vegetation Burn Severity

Vegetation that burned at moderate to high severities provides the least amount of soil cover in the first few years following the fire; it is likely that the majority of fire-induced sediment input will have occurred prior to implementation of this project due to vegetative re-growth in many areas. Low burn severity areas and unburned vegetation within a fire area maintain levels of soil cover capable of withstanding erosion. Sediment transport on moderately steep to very steep hillsides is greater than in areas with gently sloping terrain.

Stream Gradient

Streams with steeper gradients will typically store less sediment because flow velocity and the force of gravity are greater in these systems. Lower gradient streams (less than 4%) have a tendency to store sediment in pools and slow runs and impacts in these habitats would be more likely in the post-fire and post-project environment. Therefore, this analysis adjusted the sediment storage rate in streams in accordance with the associated average stream gradient.

Cumulative Effects

The spatial boundary of the cumulative effects analysis is the Rim Fire perimeter. Portions of CRLF habitat areas outside the perimeter were included in calculation for that species only in order to make relevant comparisons on percentage of habitat unit affected by project activities. The downstream extent is located close to the confluence of the Tuolumne and North Fork Tuolumne Rivers; observable effects are not expected downstream of the confluence. The temporal boundary established for cumulative effects analysis was ten years from present, a timeline commensurate with the Cumulative Watershed Effects (CWE) modeling (watershed report) which estimates disturbance acreage to develop a threshold of concern (TOC). When the TOC is exceeded there is the risk of increased sedimentation in the channel, reduction in deep water habitat volume, reduction in interstitial spaces in the streambed, greater turbidity during high stream flow and reduced primary and secondary productivity. These changes in the aquatic system can affect reproduction, ability to avoid predation and the availability of food resources. The CWE modeling indicated all streams would recover to near pre-fire levels within this time frame.

SENSITIVE SPECIES

For the FYLF and WPT, all perennial and intermittent streams below 4,200 feet were identified as suitable for the species. For the FYLF, all of these stream miles were buffered by 100 feet on both sides to provide an upland area for the frog. These two steps identified the number of stream miles to be calculated in the project area and amount of upland habitat associated with the streams. For the WPT, the same streams used for the FYLF analysis were buffered by a distance of 300 meters (984 feet) on each side to derive an upland habitat area. Both buffer areas (FYLF and WPT) are considered to contain the majority of upland habitat used by the species.

With these upland areas established, the activities proposed in each of the alternatives were placed over the upland areas to estimate the amount of area impacted by each activity for each species. This estimate was used to provide a point of reference for the amount of project-related activity occurring close to streams and provide a basis for assigning risk of direct and indirect effects to the species and their habitats.

Affected Environment

The Rim Fire affected a variety of aquatic habitats including wetlands, ponds, natural and man-made lakes, streams and rivers. The aquatic features at lower elevations, less than 2,500 feet, are primarily influenced by rainfall during the wet season (November through April), while aquatic features above this elevation are influenced by rainfall, snowpack, or a combination of both. Streams in the rainfall zone typically see peak flows following larger rain events and some intermittent streams may support surface water for several months. Streams in the rain and snow zones may see very high peak flows if rain falls on a snowpack, but streams typically show a period of peak flow as the snow melts in the late spring and early summer.

All of the larger stream systems affected by the Rim Fire are bedrock rivers (versus alluvial rivers) shaped by snowmelt runoff during the late spring (mid-May) to middle summer (mid-July). Geomorphic complexity in bedrock rivers in the Sierra Nevada requires variable annual flow (winter floods, snowmelt peak flows, winter and summer baseflow), periodic inputs of large volumes of sediments (landslides, hillslope mass wasting), and multiple flow thresholds (variable levels of flooding) (McBain and Trush 2004). Most of these rivers have steep canyons, and steep tributary streams, ascending to more gentle terrain above the canyon rim.

A very large proportion of the fire area occurred in the Tuolumne River watershed. The Tuolumne River originates in Yosemite National Park and has several large tributaries originating in the Park or on the Stanislaus. Five primary tributaries join the Tuolumne within the fire area: the Clavey and Middle, North, and South Fork Tuolumne Rivers, and Cherry Creek. The Middle and South Fork Tuolumne Rivers originate in Yosemite then flow in a westerly direction to join each other and then the main Tuolumne. Cherry Creek and the North Fork Tuolumne and Clavey Rivers originate in the Forest and primarily flow in a southerly direction into the Tuolumne. There are many minor tributaries to the Tuolumne River and its principal tributaries including: Alder, Big, Corral, Drew, Grapevine, Indian, and Jawbone Creeks (Tuolumne River); Basin and Hunter Creeks (North Fork Tuolumne River); Big Creek (South Fork Tuolumne River); Eleanor and Granite Creeks (Cherry Creek); and Hull, Reed (including Bourland, Reynolds, and Little Reynolds Creeks), and Twomile Creeks (Clavey River). Additionally, there are numerous very small, unnamed tributaries to each of these listed streams and rivers.

Obligate riparian vegetation (e.g., willow and alder) along most streams in the affected area is typically restricted to a narrow (less than 50 feet) band adjacent to the edge of the water. Some wetlands within the project perimeter support obligate herbaceous riparian species as the dominant plant community type.

The known distribution of all analyzed aquatic species follows and a description of suitable habitat for these species is also provided.

THREATENED AND ENDANGERED SPECIES

California Red-legged Frog

The CRLF is now likely extirpated from 70% of its former range (USFWS 2002). The CRLF occurred at elevations from sea level to 5,200 feet, although the highest known extant population occurs at 3,346 feet in Placer County (Barry and Fellers 2013). The historic localities in the Sierra Nevada over 3,600 feet were possibly introduced (USFWS 2002; Barry and Fellers 2013). The Fish and Wildlife Service has concurred that occurrences above 4,000 feet in the Sierra Nevada are atypical and has used this elevation as a threshold for critical habitat designation (USFWS 2006).

California red-legged frogs inhabit various aquatic habitats including ponds, marshes, streams and lagoons (Fellers 2005). The timing of breeding varies geographically, but typically occurs from November through April (USFWS 2002), which coincides with what will be referred to as the wet-season throughout this section. Females lay from 2,000 to 6,000 eggs (in masses) that are usually attached to vegetation near the water's surface. Eggs hatch in about 3 weeks. Tadpoles typically metamorphose within 11 to 20 weeks, from July to September, but overwinter aquatically at some sites (Fellers 2005; Bobzien and DiDonato 2007). Adult movements to terrestrial habitat or between aquatic habitats typically commence with the first fall rain (greater than 0.25 inches) and continue until April (Fellers and Kleeman 2007; Tatarian 2008). Adults may also disperse when aquatic habitats dry out (Fellers and Kleeman 2007). Individual movements of up to 2 miles have been reported (Fellers 2005), but 1 mile represents a more average dispersal distance (Federal Register 2010).

The CRLF Recovery Plan (USFWS 2002) identifies introduced species and habitat degradation and loss as primary drivers of CRLF population declines. Introduced bullfrogs, crayfish, fish and plants which have become established throughout much of the historic CRLF range, detrimentally affect the CRLF through predation, competition and reduced habitat quality. Agricultural and urban development have destroyed and fragmented much of the historic CRLF habitat. Other factors that may have particularly impacted Sierra Nevada populations include dams and impoundments, mining, livestock overgrazing, recreation and timber harvesting.

Project actions conducted within watersheds inhabited (none currently known) by, or containing suitable CRLF habitat, may contribute to the degradation of instream and riparian habitat. The primary effect is the potential for increased sedimentation and removal or modification of cover in terrestrial/upland habitat.

The CRLF has not been detected on the Stanislaus National Forest since 1967 and is considered extirpated from the Tuolumne River watershed (USFWS 2002) which is part of the project area.

A total of 9.7 miles of potentially suitable breeding stream habitat, 11.1 acres of potentially suitable breeding pond habitat, 55.7 miles of non-breeding stream habitat, and 21,593 acres of upland habitat was identified within the project analysis area. All other habitats were ruled out because they did not meet the suitability criteria. Within the Rim Reforestation project area five habitat units (Mather Vicinity, Drew Creek, Homestead Pond, Harden Flat and Hunter Creek) were identified that have suitable breeding habitat in streams (Drew Creek, Hunter Creek) and ponds (Birch Lake, Mud Lake, Homestead Pond and 7 unnamed ponds). Habitat characteristics including size (acres), length (miles), average depth (feet) and pre- and post-fire habitat quality determinations are summarized in Table 3.03-1. The percent of the landscape within each breeding habitat's watershed where vegetation remained unburned (UB) or burned at high (H), moderate (M) or low (L) severity is also displayed in Table 3.03-1. These values were used in determining the potential post-fire watershed response for the analysis.

Table 3.03-1 Existing Condition Summary for Suitable CRLF Breeding Habitats

Habitat	Acres	Miles[1]	Depth[2] (feet)	Elevation (feet)	VBS HIGH	VBS MOD	VBS LOW	VBS UB	Pre-Fire Habitat Quality	Post-Fire Habitat Quality
Birch Lake[3]	4.0	0.28	No data	4,500	31	14	18	37	Low	No Change
Mud Lake[3]	2.2	0.31	No data	4,500	0	55	22	23	Low	No Change
Drew Creek		1.3	1.75	2,960 to 3,300	50	23	21	5	Moderate-High	Low
Harden Flat Pond 1	0.6	0.12	No data	3,500	11	40	34	16	Moderate	Moderate-Low
Harden Flat Pond 2	0.4	0.12	No data	3,500	0	11	3	86	Moderate	No Change
Homestead Pond[3]	0.2	0.06	> 6.5	3,100	86	14	0	0	Moderate	Moderate
Hunter Creek[4]		8.4	1.6	1,600 to 4,000	13	18	18	51	Moderate	Moderate-Low
Hunter Creek Pond 1	0.4	0.10	No data	3,880	10	32	44	15	Unknown	Unknown
Hunter Creek Pond 2	0.2	0.07	No data	3,760	9	32	46	13	Unknown	Unknown
Hunter Creek Pond 3	0.2	0.08	No data	3,880	9	17	59	14	Unknown	Unknown
Hunter Creek Pond 4	0.4	0.10	No data	3,760	14	41	39	6	Unknown	Unknown
Hunter Creek Pond 5	0.4	0.10	No data	3,360	13	35	47	5	Unknown	Unknown

MOD=Moderate; UB=Unburned; VBS=Vegetation Burn Severity
[1] Miles of stream or shoreline of ponds
[2] Depths for creeks are average pool depths.
[3] Bullfrogs present
[4] Trout present

Sierra Nevada Yellow-legged Frog

Prior to 2007, *Rana muscosa* and *Rana sierrae* were considered a single species referred to as mountain yellow-legged frogs (Vredenburg et al. 2007). Genetic information indicates that the contact zone between the two species is between the middle and south forks of the Kings River. Frogs north of this point (applies to project area) are now classified as Sierra Nevada yellow-legged frogs (SNYLF, *Rana sierrae*), and those south, remain mountain yellow-legged frogs (MYLF, *Rana muscosa*). Consequently, the analysis summarized here will address the effects of project actions on the SNYLF. Where information applies to both species, the two species will be referred to collectively as the MYLF-complex.

Although frogs of the MYLF- complex were historically abundant throughout the Sierra Nevada, current research shows declines over large expanses of their range, including as much as 97% on NFS lands. Where frogs are present, their numbers are relatively low in comparison to historical estimates (Brown et al. 2014). The remaining populations are restricted primarily to publicly managed lands within National Forests and National Parks at elevations ranging from 4,500 to 12,000 feet (CDFG 2011).

Frogs of the MYLF-complex inhabit high mountain lakes, ponds, marshes, meadows, tarns, and streams. They are highly aquatic at all life stages and extensively use ponds greater than 6.5 feet deep and free of introduced fish. Despite their positive correlation with deep water habitats (Knapp 2005), both tadpoles and adults are most commonly found along open gently sloping shorelines that provide shallow waters of only 2 to 3 inches (Mullally and Cunningham 1956; Jennings and Hayes 1994; USFWS 2013b).

At lower elevations, the species is associated with rocky streambeds and wet meadows surrounded by coniferous forests (Zweifel 1955; Zeiner et al. 1988). Streams utilized by adults vary from high gradients and numerous pools, rapids, and small waterfalls to streams with low gradients and slow flows, marshy edges, and sod banks (Zweifel 1955). These frogs are rarely found in small or ephemeral streams which frequently have insufficient depth and hydro-periods for adequate refuge and overwintering habitat (Jennings and Hayes 1994).

The timing of breeding varies annually, but occurs shortly after snowmelt, typically between May and July (the dry season). Females lay clutches varying from 15 to 350 eggs (Vredenburg et al. 2005) attached to rocks, gravel, vegetation, or under banks (Wright and Wright 1949, Pope 1999). Eggs hatch in about 2.5 to 3 weeks (Pope 1999). Tadpoles may take more than one year (Wright and Wright 1949), and often require 2 to 4 years, to reach metamorphosis (Bradford et al. 1993; Knapp and Matthews 2000) depending on local climate conditions and site-specific variables. In aquatic habitats of high mountain lakes, the adult frogs typically move only a few hundred meters (Matthews and Pope 1999; Pope 1999), but single-season distances of up to 2.05 miles have been recorded along streams (Wengert 2008). Adults may move between selected breeding, feeding, and overwintering habitats during the course of the year. Though typically found near water, overland movements by adults of over 217 feet have been routinely recorded (Pope 1999). The farthest reported distance from water is 1,300 feet (USFWS 2013b).

Some factors that may impact the MYLF-complex include recreation activities, dams and water diversions, livestock grazing, timber management, road construction and maintenance and fire management activities (Helms and Tappeniner 1996; USFWS 2013b). A large increase in sedimentation could potentially damage breeding habitat. Roads may contribute to habitat fragmentation and species disturbance, but have not been implicated as primary factors in this species' decline.

In some areas, long-term fire suppression has created conditions vulnerable to increased fire severity and intensity (McKelvey et al. 1996; USFWS 2013b). Excessive erosion and siltation of habitats following wildfire is a concern in shallow, lower elevation areas below forested stands. Severe and intense wildfires may reduce amphibian survival (Russell et al. 1999). Amphibians may avoid direct mortality from fire by retreating to wet habitats or sheltering in subterranean burrows (USFWS 2013b). Because these species generally occupy high-elevation habitats, where fire is less likely to occur, this is likely a low threat.

The SNYLF has been found throughout the Stanislaus in streams, meadows and lakes at elevations between 5,400 feet and 9,700 feet, most commonly in high alpine lake habitats. No SNYLF (extant or historic) have been found within the project perimeter according to Forest Service and CNDDB records. With few exceptions, the stream occurrences associated with wet meadow systems are in streams adjacent to or connected to lakes and ponds. The majority of habitats within the project area are atypical of habitats where SNYLF are known to occur.

Within the project area there are 2.6 miles of potentially suitable breeding habitat, 5.6 miles of suitable non-breeding stream habitat, 1.3 acres of breeding habitat in ponds, and 170 acres of upland habitat. Suitable habitats include sections of three different streams (Eleanor Creek, Reynolds Creek, and the Middle Fork Tuolumne River) and two ponds (Little Kibbie Pond and Big Kibbie Pond).

SENSITIVE SPECIES

Foothill Yellow-legged Frog

The FYLF is a stream breeding frog that spends essentially all of its time in or in very close proximity to water. Breeding occurs in late spring (small streams) or early summer (larger streams) when predictable or receding flows occur and water temperatures warm. Breeding females typically attach egg masses to stable substrates (rocks) in shallow, slow water. Tadpoles emerge in a few weeks and begin feeding on algae and diatoms attached to streambed substrates. As tadpoles develop, they become wary of potential predators and seek refuge around and under streambed substrates. Tadpoles metamorphose into "froglets" by early fall and probably stay near the breeding area for the first winter. Adult and sub-adult frogs adopt one of a couple of dispersal strategies outside of the breeding season. One strategy involves moving up or downstream of the breeding area and the frogs remain on the same stream. Another strategy involves dispersal into small tributary streams near the breeding site. They may remain in these smaller streams associated with very small pools for most of the year. Sunny areas for basking and shady areas for refuge are likely important attributes in allowing the frog to regulate its body temperature. With the onset of spring, males will move to the breeding areas to establish territories and females follow several weeks to months after the males. Females probably leave the breeding site immediately following breeding. The FYLF has a known local elevation range of 900 to 4,000 feet. On the forest, the highest elevation recorded for breeding on a large river is 3,000 feet (North Fork Tuolumne River) and 3,600 feet in a small stream (Bull Meadow Creek).

The FYLF is known to occur in the following streams in the project area: Drew Creek, Grapevine Creek, and Tuolumne River (Tuolumne River watershed); Basin Creek, Hunter Creek, North Fork Tuolumne River (North Fork Tuolumne River watershed); Bull Meadow Creek, Indian Springs Creek, unnamed tributary, and Clavey River (Clavey River watershed); and Bull Creek, Moore Creek, and North Fork Merced River (North Fork Merced River watershed). Many other streams in the fire area provide suitable habitat for the FYLF, but occupancy is unknown. Below the confluence of Cherry Creek, the Tuolumne River does not provide suitable breeding habitat for the frog because of drastic fluctuations in water associated with releases from Dion Holm Powerhouse on Cherry Creek. These fluctuations occur rapidly and daily during the breeding period, and are probably large enough to either scour or strand egg masses, both mortality events. Also, the cold water temperatures associated with the discharges may be enough to slow development and prevent metamorphosis in a timely manner. The Tuolumne River likely played an important role in supporting a number of interconnected sub-populations along the river prior to the construction of upstream dams. This assertion is supported by the presence of FYLF populations in most of the main tributaries and in the Tuolumne itself upstream of Early Intake.

Most of these populations, especially in small streams (e.g., Basin Creek) are believed to be small and consist of less than 20 adults. In the small tributaries that offer dispersal habitat, there could be very few individuals occupying the stream. The Clavey River is probably the largest remaining population of FYLF in the southern Sierra Nevada. Frogs are known to breed at the confluence with the Tuolumne River and above the bridge on Forest Service Road 1N01 (9 miles) and this analysis assumes multiple breeding locations between these two points. Also, the river provides many more miles upstream of the bridge that are suitable for breeding. Table 3.03-2 shows miles of suitable and occupied FYLF habitat, occupancy status, and whether surveys were conducted on the streams.

Table 3.03-2 Occupied and Suitable Habitat for FYLF in the Project Area

Watershed and Streams (5th level HUC)	**Size** (acres)	**Occupancy**	**Survey**	**Suitable** (miles)	**UHA**
Tuolumne River	819,000	Yes	Yes	36.5	870
Alder Creek	1,525	Unknown	Yes	5.5	132
Corral Creek	4,570	Unknown	Yes	9.6	230
Drew Creek	1,697	Yes	Yes	4.6	110
Grapevine Creek	4,488	Yes	Yes	10.8	260
Indian Creek	2,344	Unknown	No	2.7	64
Jawbone Creek	13,136	Unknown	Yes	14.3	343
Middle Fork Tuolumne River	46,635	Unknown	Yes	25.5	612
North Fork Tuolumne River	63,849	Yes	Yes	75	1,796
Basin Creek	9,030	Yes	Yes	17.8	427
Hunter Creek	9,482	Yes	Yes	21.5	515
South Fork Tuolumne River	57,855	Unknown	Yes	29.4	704
Cherry Creek	90,892	Unknown	No	17.8	428
Eleanor Creek	59,906	Unknown	No	2.3	55
Granite Creek	4,110	Unknown	Yes	6.0	144
Clavey River	100,645	Yes	Yes	29	696
Reed Creek	24,527	Unknown	Yes	4.2	101
Adams Gulch	815	Unknown	No	0.8	18
Bear Springs Creek	2,403	Unknown	Yes	1.9	45
Bull Meadow Creek	1,430	Yes	Yes	3.0	71
Indian Springs Creek	356	Yes	Yes	0.8	20
Quilty Creek	1,089	Unknown	Yes	1.8	44
Unnamed Tributary 1	773	Unknown	No	1.5	36
Unnamed Tributary 2	373	Unknown	No	1.0	25
Unnamed Tributary 3	1,343	Unknown	Yes	2.3	56
Unnamed Tributary 4	490	Unknown	Yes	1.0	24
Unnamed Tributary 5	688	Yes	Yes	1.7	41
Cottonwood Creek	5,307	Unknown	Yes	2.3	56
Russell Creek	560	Unknown	No	0.8	20
North Fork Merced River	79,110	Yes	Yes	74.4	1,784
Bull Creek	21,064	Yes	Yes	44.7	1,072
Deer Lick Creek	3,981	Unknown	Yes	9.7	233
Moore Creek	5,896	Yes	Yes	11.9	286
Scott Creek	1,627	Unknown	Yes	1.9	46

UHA=Upland Habitat Acres (30-meter buffer)

The analysis area for the FYLF includes the Tuolumne River watershed from Hetch Hetchy in Yosemite National Park to the backwaters of Lake Don Pedro. For this portion of the Tuolumne River watershed, the analysis area extends upstream each tributary to the project boundary. In many instances, the entire watershed area of the smaller tributaries is within the project area (e.g., Grapevine, Corral, and Alder Creeks). For other tributary watersheds, only a portion of the total watershed area is affected (e.g., Clavey and the Middle, North, and South Forks of the Tuolumne). For the North Fork Merced River (about 100,000 acres), the project area only includes a small portion of several headwater tributaries and the analysis boundary only includes the upper portion of the North Fork Merced watershed, or the 37,000 acres in the 6th level HUC.

Western Pond Turtle

The WPT is a species that requires both aquatic and terrestrial habitat to meet its life history needs. Aquatic habitats are needed for breeding, eating, overwintering, regulating body temperature, refuge, and rearing hatchlings. Terrestrial habitats are required for nesting, aestivation, overwintering, and regulating body temperature. The WPT mates under water and the females excavate a nest adjacent to aquatic habitat. Nests are typically constructed in open areas (little or no canopy cover) with well-drained soil and on gentle slopes with good solar aspect (south to west facing slopes). The nests are typically found within 300 feet of the aquatic feature used by adults, but can be found almost 0.25 mile away from the water. The eggs hatch in several months, but the hatchling turtles remain in the nest until the following spring or early summer. The hatchlings seek slow, shallow, and warm water where they can forage and grow. Adult and sub-adult turtles can spend much of their year within a small geographic area; however, they sometimes make long overland or upstream-downstream movements (Reese 1996). Like the FYLF, the turtle prefers a variety of microhabitats for regulating body temperature, but basking sites are most important in the early season when air and water temperatures are relatively low. Basking is also important for females since elevated body temperature contributes to the development of the eggs.

Table 3.03-3 Occupied and Suitable Habitat for WPT in the Project Area

Watershed and Streams (5th level HUC)	Occupancy	Survey	Suitable (miles)	Suitable (acres)	UHA
Tuolumne River	Yes	Yes	36.5		8,711
Drew Creek	Yes	Yes	4.6		1,011
Grapevine Creek	Yes	Yes	10.8		2,565
Jawbone Creek	Unknown	Yes	14.3		3,411
Three unnamed ponds	Unknown	No		10.0	277
Middle Fork Tuolumne River	Yes	Yes	25.5		5,365
Abernathy Meadow	Yes	Yes	7.5		132
Grandfather Pond	Yes	Yes		0.2	82
Mud Lake	Yes	Yes		3.0	115
North Fork Tuolumne River	Yes	Yes	75		16,718
Basin Creek	Unknown	Yes	17.8		3,902
Hunter Creek	Yes	Yes	21.5		4,912
South Fork Tuolumne River	Yes	Yes	29.4		6,411
Cherry Creek	Unknown	No	17.8		3,737
Eleanor Creek	Unknown	No	2.3		599
Big Kibbie Pond	Yes	Yes		1.0	98
Little Kibbie Pond	Yes	Yes		0.5	86
Clavey River	Yes	Yes	29		3,460
Reed Creek	Unknown	Yes	4.2		904
North Fork Merced River	Yes	Yes	74.4		16,908
Bull Creek	Yes	Yes	44.7		9,879
Deer Lick Creek	Unknown	Yes	9.7		2,234
Moore Creek	Yes	Yes	11.9		2,767
Scott Creek	Unknown	Yes	1.9		453

UHA=Upland Habitat Acres (30-meter buffer)

While water is required for some life history aspects, the WPT can use seasonally wet habitats. During periods when the aquatic feature is dry, turtles can depart the feature for another nearby aquatic habitat or can venture into the terrestrial environment to aestivate. Aestivation is a seasonal reduction in activity and body function similar to hibernation. The turtles will locate a site where they can dig into the leaf duff, preferably with some overhead cover (shade), and wait until the rain replenishes the aquatic habitat. Turtles can also use the terrestrial environment during the winter. The behavior, overwintering, is similar to aestivation because they leave the water (around October), bury themselves into the leaf litter under trees or shrubs, and wait until spring. During this time, they may move about on the landscape or move to water then back to land.

The WPT is often found in habitats occupied by the FYLF because they share many of the same habitat needs. On the Forest, almost all occurrences of turtles in streams are at elevations less than 3,500 feet, but several populations are in ponds at elevations up to 5,400 feet. Table 3.03-3 shows the streams, ponds, and meadow with known WPT populations and lists the primary streams that provide suitable habitat for the turtle.

Hardhead

The hardhead is a large species of minnow that historically occurred in a narrow low-elevation zone, approximately 100 to 1,500 feet in elevation, in the foothills of the Sierra Nevada (Moyle 2002). Moyle (2002) included the hardhead as one component of an assemblage of native warm water species called the pikeminnow-hardhead-sucker assemblage. On the Stanislaus, California roach (a minnow), riffle sculpin, and rainbow trout could also occur with the hardhead in rivers with unregulated flows (no dams). The species description given in Moyle (2002) is the basis for the species and habitat description that follows.

Hardhead can be found in a variety of flowing water habitats from large intermittent foothill streams to large rivers. Larger individuals are typically associated with deep pools while smaller individuals are associated with shallow waters along stream edges. For most of the year, the fish does not move extensively up- and downstream, opting to remain in a pool or series of pools linked by deep run habitat. Hardhead spawn in the spring (April and May) and may migrate upstream long distances in larger streams, especially those impacted by reservoirs. Like other minnows, hardhead likely spawn in gravel substrates in run habitat or at the tail-out of pool habitat. Older fish are omnivorous, feeding on a mix of filamentous algae and invertebrates (e.g., crayfish, aquatic insects). Smaller fish tend to feed more on aquatic insects or other small invertebrates (e.g., snails). Hardhead appear to prefer warm [greater than 20 degrees Centigrade (68 degrees Fahrenheit)] water, but like to have access to deeper, cool water as water temperatures increase throughout the summer. Alteration of habitat and streamflow by dams and the introduction of predatory fish (mainly bass) have had major impacts on the distribution and abundance of the hardhead.

The status of hardhead in the Tuolumne River is unclear. There are no records of hardhead from above Don Pedro Reservoir, but Moyle (2002) indicates a dramatic population decline following impoundment of the Tuolumne River. However, streamflow is regulated in the Tuolumne all of the way up to O'Shaughnessy Dam and Dion Holm Powerhouse on Cherry Creek, a main tributary to the Tuolumne. Forest Service personnel have conducted snorkel surveys in the lower Clavey River and observed schools of large minnows; but, hardhead are difficult to differentiate from Sacramento pikeminnow when observed from a distance. Hardhead may persist in the lower Clavey River, North Fork Tuolumne River, and possibly Cherry Creek upstream of Holm Powerhouse. In addition, fish surveys conducted on the Tuolumne River upstream of Early Intake have not determined the presence of hardhead either [personal communication with Mike Horvath, San Francisco Public Utilities Commission (Hetch Hetchy Regional Water System, Natural Resources Division)].

Expected Post-Fire Watershed Response

The Rim Fire affected a large portion of the Tuolumne River watershed and the previously forested landscape has been altered sufficiently that many of the "normal" watershed processes have been altered, sometimes dramatically. These processes include erosion of soil from hillslopes and stream channels, storage and transport of sediment in stream channels, stream flow, LWD recruitment, and maintenance of cool water temperatures. Two years post fire sprouting species and others are returning and the high severity vegetation burn areas which average over 70% shrub cover.

Hillslope erosion is a natural process that typically occurs at very low rates [0.1 to 0.5 tons per acre (USDA 2013)] in forested conditions. This rate can increase tremendously in landscapes affected by wildfire, sometimes greater than four orders of magnitude (10 to greater than 100 tons per acre). Factors that contribute to the extent to which the soil erodes include, but are not limited to, soil texture, steepness of hillslope, amount of ground cover, and rainfall intensity.

Given large increases in erosion in the fire area, there will be areas with large volumes of sediment delivered to stream channels. Many of the small streams will be drastically altered by this sediment with the most obvious change being the streambed covered with fine sediment (the stream is "silted in"). Using the recent Bagley Fire on the Shasta-Trinity National Forest as an example, Forest Service employees measured sediment depths in excess of one meter (3.3 feet) in some stream channels (USDA 2013). While this example is a "worst case scenario" (caused by two uncommonly large storm events separated by a short period of time), our observations at one stream in the fire area, Skunk Creek, indicated the sediment was 1 to 2 inches deep following a below average precipitation year with relatively low intensity precipitation (to date). When large volumes of sediment are delivered to a stream channel, habitat complexity is reduced as pool and run habitats fill in and the stream bottom becomes relatively uniform. In larger streams like the Clavey River, extensive sedimentation could occur, but major reductions in pool volume are not likely because the energy of the streamflow is enough to keep the sediment moving downstream. Post-fire erosion rates can return to pre-fire rates within five to ten years. As stated previously, substantial shrub re-growth is already reducing the magnitude of sediment movement a few years post-fire.

With the loss of vegetation and leaf duff layer on the ground, the amount of flow in the streams, both base flow and peak flow, is generally expected to increase. This is because the trees are no longer taking up water through their roots and transpiring that water through their leaves (base flow) and the water repellent layers will cause the water to run off of the soil surface without being absorbed into the leaf duff layer and soil (peak flow). Peak flows can increase many times over in watersheds with extensive high severity burn conditions, especially following periods of high intensity rainfall, or rainfall of long duration and large amounts. As the streamflow begins to peak after a heavy rainfall in a burned watershed, the channel and streambanks are scoured by the water and the banks are eroded away. This is called channel erosion and it can be a significant source of sediment after a fire. With the loss of trees and other vegetation transpiring water, base flows can increase several fold throughout the year. Exaggerated peak flows (compared to pre-fire) should continue for three to five years after the fire, and increased base flows could continue for many decades.

The amount of sediment in the channel that is moved downstream or stored in the channel (and floodplains) depends on several factors, primarily streamflow and the gradient, or steepness, of the stream. In general, the steeper the stream is, the easier it is to transport the fine sediment downstream. Large streamflows have more energy than lesser flows and are capable of moving large quantities of sediment. In the five to ten years after the fire, channel conditions should be close to pre-fire conditions.

LWD recruitment generally increases after a fire because fire-killed trees eventually fall. Some of the trees fall into streams where they can influence stream morphology by catching sediment upstream of the tree and creating pool habitat downstream of the tree. Log jams can effectively trap and store large volumes of sediment for very long periods of time (greater than 50 years). The sediment stored behind the LWD can become important habitat for many aquatic species. The recruitment of LWD in streams is highest in the 10 to 20 years following a fire.

Water temperatures generally increase in the post-fire environment. This is largely due to the loss of vegetation providing shade to the surface of the water. In heavily forested conditions, very little direct sunlight hits the water and cool or cold water temperatures are maintained. When canopy cover is lost, stream temperatures can increase five degrees Fahrenheit or more for several years following the fire. Obligate riparian vegetation (examples, willow and alders) typically re-grows quickly and provides enough shade to maintain cool and cold water.

For the FYLF, the impact to aquatic habitat is based on expected post-fire watershed response at various watershed scales. The estimates rely on the following: 1) the extent to which a watershed was affected by fire, 2) the extent of high and moderate severity fire in a watershed, 3) stream gradient, and 4) sediment yield calculations when compared to pre-fire conditions. The Watershed Report provides a general narrative for how the primary watersheds (fifth and sixth level HUC) have responded post-fire, and those evaluations were used to put the FYLF watersheds into categories of watershed response.

Three general categories were used for these watersheds: low, moderate and high post-fire response. For the low category, the post-fire watershed responses may not be readily observable at suitable breeding sites. In moderate concern habitats, extensive sedimentation of all habitats is expected, but deep water habitats should be maintained by the scouring action of water. In high concern watersheds, major impacts are expected to all habitat types, especially significant reduction of pool and other deep water habitat. The ability to reproduce is considered to be a key factor in maintaining recruitment as the watersheds recover, because most populations are small and the loss of a recruitment class could have a population-level consequence. Deep water habitats are refuges and critical to overwintering success and escape from predation attempts. Table 3.03-4 lists the watersheds suitable for FYLF and the expected level of watershed response.

Table 3.03-4 Watersheds and Streams with FYLF Suitable Habitat with Watershed Post-fire Response

HUC Level and Name	Stream	Watershed Response
5. Big Creek-Tuolumne River	Big Creek	Low
6. Grapevine Creek-Tuolumne River	Tuolumne River, Indian	Low
	Grapevine	Moderate
6. Jawbone Creek-Tuolumne River	Tuolumne River	Low
	Drew	Moderate
	Alder, Corral, Jawbone	High
5. North Fork Tuolumne River	North Fork Tuolumne River, Basin	Low
	Hunter	Moderate
5. Clavey River	Clavey River	Low
6. Lower Clavey River	Clavey River	Low
	Unnamed Tributaries 1-5, Adams Gulch, Bear Springs, Bull Meadow, Indian Springs, Quilty	High
6. Middle Clavey River	Clavey River, Cottonwood	Low
	Russell	Moderate
6. Reed Creek	Reed Creek	Low
7. Lower Reed Creek	Reed Creek	Moderate
5. Cherry Creek	Cherry	Moderate
6. Lower Cherry Creek	Granite	High
5. Eleanor Creek[1]	Eleanor Creek	Moderate
5. Falls Creek-Tuolumne River[1]	Tuolumne River	Low
5. Middle Fork Tuolumne River[1]	Middle Fork Tuolumne River	Moderate
5. South Fork Tuolumne River[1]	South Fork Tuolumne River	Moderate
5. North Fork Merced River	North Fork Merced, Bull, Deer Lick, Moore Creek, Scott Creek	Low

Environmental Consequences

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

General Effects Common to all Species

Mortality and Injury

The use of heavy equipment, application of herbicides and implementation of prescribed fire all have the potential to directly injure or kill aquatic organisms, particularly those occupying upland habitats. While most organisms close to water would be expected to escape into the water, a typical behavioral response by the FYLF and WPT, equipment can run over individuals that fail to flee or are unable to move, and prescribed fire can injure or kill organisms that remain onsite.

Four herbicides are proposed for use under this alternative, for site preparation and release (glyphosate) and noxious weed eradication (glyphosate, clethodim, aminopyralid and clopyralid). "Hazard quotient" represents the ratio of toxicant exposure to a reference value that corresponds to a threshold of toxicity; a hazard quotient of "1" is the level at which adverse effects could occur. The SERA risk assessments prepared for the project indicate a hazard quotient of "1" is not expected to be exceeded for amphibians for any of the chemicals applied at specified application rates; sensitive fish were used as a proxy for amphibians when data was lacking. In most cases, hazard quotients were at least an order of magnitude less than 1. Under the unlikely event of "acute accidental" exposure, clethodim exceeds a hazard quotient of 1 for sensitive fish, with a value of 1.5; however, management requirements (e.g., refilling backpack sprayers away from water) are expected to reduce this risk to a very low level.

Physical Disturbance

Heavy equipment use or forest workers close to a stream could affect the behavior of aquatic organisms that are in the terrestrial environment. The typical response is for an individual to flee into water. Individuals typically hide under streambanks, rocks or logs for up to 30 minutes and then return to the edge of the stream. They seek refuge if disturbed again and typically stay submerged longer or move away from the disturbance. Physical disturbance may interrupt basking, sleeping, or foraging, creating the potential to affect physical well-being. A single instance of disturbance may have negligible or no effect on an individual, but repeated disturbance has the potential to affect the physiological fitness of individuals (Rodriguez-Prieto and Fernandez-Juricic 2005).

Modification of Habitat

The primary impact to habitat expected from the proposed activities is an increase in sediment delivery caused by equipment operations on fire-affected soils; to a lesser extent, sediment increases can occur through hand methods (e.g., manual grubbing), prescribed fire, and the use of herbicides (e.g., slightly increased soil exposure to precipitation events from leaf loss). The operation of heavy equipment (e.g., deep tilling) on fire-impacted soils and in near stream environments can result in ground disturbance capable of mobilizing susceptible soil types. Numerous project units coincide with areas of moderate and high burn severity, conditions that are more sensitive to disturbance. These areas typically have alterations in soil structure that make them more vulnerable to erosion and lack beneficial ground cover which can reduce erosion rates; numerous protective measures are in place to minimize these potential effects (3.11 Soils and 3.15 Watershed).

Excess sediment can cause a reduction of deep water habitats (pools and runs), loss of microhabitat complexity and filling the streambed with fine sediment. Pool and run habitats can be filled by excess sediment, especially in low gradient (less than 2%) reaches. The energy of water in higher gradient reaches (greater than 5%) tends to have enough erosive force to keep pools scoured and deep water maintained, but the overall pool volume may be reduced in low energy sites as sediment accumulates at the edges and tail of the pool. Excess sediment also reduces microhabitat complexity and the spaces between streambed substrates by filling the streambed with finer sized sediments (silts and sands). In lower gradient streams, the overall depth of the stream is typically reduced as the streambed fills with sediment and the water spreads out in a thin layer across this sediment. The loss of the small changes in streambed depth reduce microhabitat elements by eliminating velocity refuges and filling the spaces between larger substrates (gravel, cobble, and boulder) that are used by some species for breeding, foraging, and hiding. The change in streambed also influences the production of aquatic insects that use, including very specialized use, microhabitats in otherwise unimpaired streams. Aquatic insects play key roles in the breakdown of organic matter entering streams, nutrient cycling, and as sources of food for many aquatic and terrestrial species. Project protective measures are expected to reduce the risk and magnitude of these potential effects to low levels (3.11 Soils and 3.15 Watershed). Sediment would be expected to return to natural levels within a few years after project implementation.

Though observable direct effects to aquatic species are not expected to occur from herbicide use, effects to habitat are expected. The primary effect would be the reduction of terrestrial vegetation cover (mostly shrubs) in the short-term, while more rapid growth and distribution of tree-type vegetation is anticipated in the longer term. Most of this reduction is expected to occur away from waterbodies, as existing riparian vegetation would be left intact. Vegetation recovery would be variable in both spatial and temporal contexts, as multiple herbicide applications could occur in some areas. Indirect effects are also possible as a result of changes to aquatic and terrestrial food sources. For example, macrophytes, algae, and some invertebrates could be affected by herbicide use, as they are generally much more sensitive to herbicide effects (risk assessment worksheets) than vertebrate species. In the absence of an "accidental acute" exposure scenario, these potential effects would likely be limited to a very small percentage of project waters due to multiple management requirements that limit treatment near water and existing riparian vegetation.

LWD plays very important roles in the development of habitat complexity and sediment retention in a stream (USDA 1988; Montgomery et al. 1996; May and Gresswell 2003). It may take several centuries (greater than 300 years) for some portions of the forest to regrow large trees. This alternative is designed to hasten the growth of trees as compared to natural recovery rates, reducing the time necessary to create LWD for recruitment to aquatic habitats.

California Red-legged Frog

Direct and indirect effects to individual California red-legged frog individuals include disturbance, injury or mortality, and reduced fitness as a result of repeated disturbance or a reduced food supply. Because California red-legged frog is considered to be extirpated from the Tuolumne River basin (USFWS 2002) these effects are discountable. However, because extensive surveys to confirm this have not been completed for the frog within the project area and suitable physical habitat exists, these potential effects will be discussed.

Direct and indirect effects to habitat include a small reduction in shade; reduction in large downed wood recruitment that can alter stream form and limit creation of downstream habitat (pools) and reduce cover in upland areas; streambank damage from operation of equipment; a risk of chemical contamination from herbicide use, and increased sedimentation as a result of mechanical operations. As stated previously, numerous protective measures (e.g., BMPs, project management requirements) are in place to minimize or prevent these effects.

Effects to individuals are mainly associated with the operation of equipment, presence of forest workers in suitable habitats for the frog, prescribed fire, and potential water drafting. If equipment operates in suitable habitat, there is the risk of injury or mortality when the disturbance is initiated. As activities move further from aquatic habitat the risk is reduced, although California red-legged frogs can be found in the upland habitat for extended periods in rodent burrows or under available cover (moist vegetation and downed wood). Any frogs in the upland habitat could be vulnerable to crushing if the equipment hits or runs over the cover object. As the amount of activity in the upland habitat increases, so does the risk. Because red-legged frog are considered extirpated from the Tuolumne River basin, this risk is expected to be very low. The amount of are proposed for treatment within upland habitat is used as an indicator of risk.

As stated above, physical disturbance is also a direct impact to individuals and is associated with equipment operation and forest workers in close proximity to suitable habitats. Red-legged frog are generally associated with aquatic habitats, but can be found in upland habitats for extended times. Many overland movements of red-legged frogs are associated with the wet season when implementation activities are stopped. Because the risk of direct impact is highest when equipment works in close proximity to the water, the amount of potentially suitable habitat near water and overlapping proposed activities is used as an indicator of risk. Table 3.03-5 identifies the number of miles and acres for each species.

Indirect impacts to individuals can occur when excessive sedimentation modifies habitat. When excess sediment is supplied to a stream, deep water habitat can be reduced, the spaces between and under stream substrates (interstitial spaces) are filled in, and sediment covers suitable foraging substrates. Depth reduction of deep water habitats (pools and runs) can affect availability of breeding habitat. If the reduction of depth persists over many years, there could be population level impacts because reproductive success would be periodically reduced or eliminated. Excessive sedimentation also can fill in interstitial spaces and reduce the instream overhead cover available to all life stages. Red-legged frog tadpoles typically retreat to deep water and have also been observed burrowing in to sediment to escape (Bobzein and Didonato 2007). An increase in predation could result if these refuge habitats are limited. California red-legged frog tadpoles feed on algae and adult frogs feed on macroinvertebrates (USFWS 2010). In stream habitats the larger substrates provide the algal resources. As excessive sedimentation begins to cover the streambed, the substrates used for foraging can also be covered, thereby resulting in decreased opportunities for feeding. The consequences of reduced food supply for tadpoles means slightly longer developmental time to metamorphosis and reduced size at metamorphosis. Longer developmental times could increase predation risk as metamorphosis occurs and tadpoles are less mobile due to presence of legs and the physiological cost of transforming the body. Smaller size at metamorphosis could affect individual survivorship over winter. Project management requirements are expected to reduce potential impacts (2.02 Alternatives Considered In Detail).

Herbicide use within potential habitat, both near aquatic and upland (up to 1 mile from suitable breeding sites), is restricted to glyphosate and aminopyralid formulations. These two herbicides are commonly used near aquatic habitat due to their lower toxicity to aquatic organisms. Risk assessments for this project show low risk to individual amphibians under the expected exposure scenarios, even without considering application buffers (e.g., 107 feet from aquatic habitat). As stated previously, risk is further reduced because it is unlikely this species are present.

Effects to habitat should be mostly limited to a short-term reduction in vegetative cover in the upland terrestrial environment, most of which will be located a substantial distance from aquatic habitat due to project protective measures (2.02 Alternatives Considered In Detail); riparian impacts, such as temperature change due to near-water vegetation removal are not expected to occur due to these protective measures. The operation of equipment and use of herbicides can potentially damage cover in upland habitats as vehicles crush vegetation and displace large woody debris. The loss of cover could negatively impact the ability of red-legged frogs to forage or hide from predators. Equipment could also crush partially decayed logs and reduce potential refuge habitat under the log, though much of this cover type was lost in the fire. The consequences of the loss of cover provided by riparian vegetation would be very minor, because the extent of habitat loss would be limited to the few areas where equipment operation would occur in suitable habitat, and temporary, because the near-ground vegetation would likely regrow within a few years. The project is expected to increase the rate of tree growth, both for planted conifers and most remaining native tree species, the majority of which would occur outside areas where riparian vegetation is re-establishing naturally.

An increase in the rate of sediment delivery to streams following deep tilling, machine piling, pile burning, and to a lesser extent, herbicide use and manual release methods could occur. These activities create soil disturbance and compaction that can lead to increased erosion and sedimentation. Vegetation removal has a potential for increasing sediment delivery to aquatic systems because ground based equipment creates soil disturbance, some of which may be mobilized during precipitation events. However, the potential for biologically important levels of sedimentation is low because the area affected represents a very minor percentage of total near-water area. Pile burning also creates the potential for slight increases in sediment because the burn piles can cause localized soil hydrophobicity under the fire due to high temperatures and relatively long residence time. The potential for extensive off site soil movement is low because the piles tend to be small (20 to 50 square feet), but machine piles can have a much larger footprint (1,000 to 5,000 square feet).

Herbicide use for site preparation, release and noxious weed abatement would reduce near-ground cover for a period of a few years. Noxious weed treatments would only treat the targeted plants, allowing for an increase in native vegetation within a few years, an outcome that is assumed to be beneficial to native amphibians.

LWD should not be displaced in near-water habitat during mechanical site preparation treatments. Only small diameter trees would be piled and this would only occur in a minority of these areas.

Water drafting is required by the project for dust abatement on roads when thinning existing plantations. Drafting has the potential to suck in tadpoles (entrainment) or other small life stages as the pump pulls water from a stream. Entrainment and passage through the pump could be fatal to individuals or if the water is dispensed on a road or during fuels management activities (pile burning) in an upland area, mortality would likely result. The operation of the drafting pumps generate noise and workers attending to the pumps also create a source of physical disturbance. To mitigate the potential for entrainment, the management requirement applied to drafting operations includes use of low intake velocity pumps and a screening device placed around the pump intake.

Table 3.03-5 CRLF and SNYLF Direct and Indirect Effect Indicators for Each Alternative

Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
California red-legged frog					
Miles of stream habitat within units	12.4	0	12.4	1.2	12.4
Acres of breeding ponds within units	0	0	0	0	0
Acres of habitat within units – all treatment types[1]	4,044.0 (18.7%)	0 (0%)	4,044.0 (18.7%)	459.7 (2.1%)	4,044.0 (18.7%)
Herbicide use for noxious weeds[2]	577.9	0	0	0	577.9
Sierra Nevada yellow-legged frog					
Miles of suitable breeding /non-breeding stream within units	0.4	0	0.4	0	0.4
Acres of breeding/non-breeding ponds within units	0.8	0	0.8	0	0.8
Acres of upland habitat within units – all treatment types	2.0	0	2.0	0	2.0
Herbicide (within 107 feet) near-stream for reforestation or noxious weeds	0	0	0	0	0

[1] Includes near-aquatic and upland habitat combined. Percentages represent the total in the Rim Reforestation project area.
[2] Majority (>90%) of acreage overlaps with reforestation units, where only glyphosate is proposed for treatment. Only glyphosate and aminopyralid are allowed in California red-legged frog terrestrial habitat, with no application to aquatic habitat.

Birch and Mud Lakes

No activities are proposed in the immediate vicinity of Mud Lake and all proposed activities occur downstream and/or downslope of the breeding habitat. No risk of injury or disturbance at the breeding habitat exists. No risk of increased sediment reaching the ponds due to project activities exists, or in reduced shading and an associated increase in temperature. The habitat suitability of the ponds would remain low post-implementation.

About 0.8 miles of non-breeding stream habitat overlaps proposed reforestation units. Minor quantities of sediment may enter the non-breeding aquatic habitat due to reforestation treatments.

Removal of small quantities of small diameter trees is not expected to reduce shade to an extent that would lead to increased water temperatures. LWD recruitment would not be affected along the non-breeding stream segments.

Approximately 10% of available upland habitat would be treated mechanically and with herbicide (glyphosate). These activities can decrease post-fire re-growth that has occurred in the short-term; an increase in conifer re-growth is expected in the longer term, while existing riparian vegetation is expected to remain largely unaffected. There are no activities proposed within the dispersal habitat between Birch and Mud Lakes.

Drew Creek

The breeding habitat along Drew Creek is not included within any proposed reforestation units and no risk of disturbance to breeding habitat exists. Only a few acres of reforestation treatments are proposed along non-breeding stream habitat. The small area of anticipated disturbance is not expected to result in detectable sediment above the background of the post Rim Fire erosion.

The proposed activities would not measurably alter stream shading. There is very little activity proposed in this habitat area adjacent to streams.

Noxious weed treatment would occur along about 0.56 miles of non-breeding stream, and within 120 acres (less than 5% of total upland habitat). Glyphosate and aminopyralid are proposed in this area. Near-ground cover would be reduced for a few years after application of glyphosate, but aminopyralid would only be applied to the noxious weeds and would have little effect on native plants. Native plant species would re-colonize and occupy the majority of treated areas post-treatment, which is assumed to be a benefit for all native amphibian species.

If any California red-legged frogs are in the upland habitat at the time of activities, they would be at risk for disturbance or injury. Dispersal in the habitat occurs along Drew Creek and proposed activities would have no effect on the existing habitat.

Harden Flat Ponds

No reforestation treatments are proposed near the ponds and no risk of injury or disturbance at the breeding habitat. No risk of increased sediment reaching the ponds exists and the habitat suitability of the pond would remain unchanged.

About 0.25 miles of non-breeding stream habitat and 300 acres (less than 50% of available habitat) of upland habitat overlap proposed reforestation units. It is possible that implementation activities could result in some erosion and small quantities of sediment delivery to the stream. Removal of generally small diameter trees is not expected to reduce shade to an extent that would lead to increased water temperatures. LWD recruitment would not be effected. Reforestation activities can decrease cover and set back vegetative regrowth by a few years.

About 2 acres of available upland habitat is proposed for noxious weed treatment. Risk assessments indicate that herbicide concentrations would remain below levels capable of directly affecting amphibians; the risk assessments do not consider project management requirements (e.g., application buffers), which are expected to further reduce/prevent the risk of herbicide contamination. Some near-ground cover would be reduced for a few years after application, but noxious weed applications target the invasive species specifically and should not impact most other plants in the area. Presumably, native plant species would occupy the majority of these areas post-treatment, which is assumed to be a benefit for all native amphibian species. Both glyphosate and aminopyralid are proposed for noxious weed eradication, while reforestation treatments are only proposing glyphosate.

Homestead Pond

No reforestation units are located near Homestead pond. No risk of injury or disturbance at the breeding habitat or impact to habitat suitability of the pond would occur.

About 0.36 miles of non-breeding stream habitat and 285 acres (less than 20% of available habitat) of upland habitat overlap proposed reforestation units. It is likely that implementation activities would result in some erosion and there would be some sediment delivery to the stream. Removal of generally small diameter trees is not expected to reduce shade to an extent that would lead to increased water temperatures. Reforestation activities can further decrease cover from the effects of the fire, and can set back vegetative regrowth by a few years. If any California red-legged frogs are in the upland habitat at the time of reforestation activities, they would be at risk for disturbance or injury.

About 300 acres of available upland habitat is proposed for noxious weed treatment, with 0.36 miles of stream habitat contained within these areas. The majority of this acreage overlaps with the 285 acres of reforestation units. One unit is located approximately 100 feet west of Homestead pond; this distance is expected to be sufficient in preventing any herbicide contamination. Risk assessments indicate that herbicide concentrations would remain below levels capable of directly affecting amphibians; the risk assessments do not consider project management requirements (e.g., application buffers), which are expected to further reduce/prevent the risk of herbicide contamination. Near-ground cover would be reduced for a few years after application. Native plant species would re-colonize and occupy the treated areas and this is assumed to be a benefit for all native amphibian species. Both glyphosate and aminopyralid could be used for eradication treatments, while reforestation only proposes the use of glyphosate.

Hunter Creek and Ponds

No reforestation units are located near the ponds. There is no risk of injury or disturbance at the breeding habitat. There is no risk of increased sediment reaching the ponds due to project activities, or in reduced shading and an associated increase in temperature. The habitat suitability of the ponds would remain the same.

About 11 miles of stream habitat (2 miles are potential breeding habitat), and 3,000 acres (less than 35%) of upland habitat overlap proposed reforestation units. It is likely that implementation activities would result in some erosion and there would be some sediment delivery to the stream. Removal of generally small diameter trees is not expected to reduce shade to an extent that would lead to increased water temperatures. LWD recruitment may be slightly reduced along the non-breeding stream segments, but most would be small diameter. Reforestation activities can decrease cover and can set back vegetative regrowth by a few years. If any California red-legged frogs are in the upland habitat at the time of reforestation activities, they would be at risk for disturbance or injury.

About 150 acres of available upland habitat is proposed for noxious weed treatment, with 2.5 miles of stream habitat contained within these units. Risk assessments indicate that herbicide concentrations would remain below levels capable of directly affecting amphibians; the risk assessments do not consider project management requirements (e.g., application buffers), which are expected to further reduce/prevent the risk of herbicide contamination. Near-ground cover would be reduced for a few years after application. Presumably, native plant species would re-colonize and occupy the majority of treated areas post-treatment, which is assumed to be a benefit for all native amphibian species. Both glyphosate and aminopyralid could be used in noxious weeds units, while reforestation units without noxious weeds would be treated with glyphosate only.

Sierra Nevada Yellow-legged Frog

Despite extensive surveys of suitable habitat no SNYLF have been found within the project area and most habitat is of relatively low quality. Because occupancy is not definitively known in all areas, effects to individuals are considered. A more comprehensive, detailed description of effects is available in the Biological Assessment and Biological Evaluation.

Proposed activities overlap 0.4 miles of stream and 0.8 acres of pond habitat (Table 3.03-5). Survey efforts at the Kibbie Ponds have been adequate to determine the ponds are unoccupied and therefore no impacts to individuals are expected to occur.

About 2 acres of treatment are proposed within 82 feet of potential habitat along the Middle Fork Tuolumne River at the border with Yosemite National Park. These units are proposed for thinning only. Direct impacts to individuals from tree felling could theoretically occur, though the likelihood is low because these large streams are atypical of SNYLF habitats on the forest and have self-sustaining populations of fish. In addition, occupancy is very unlikely at these sites and the risk to individuals is very low. SNYLF hiding in burn piles could be killed, injured, or disturbed if they are present when piles are ignited. Project management requirements ensure burn piles are located a minimum of 50 feet from perennial and intermittent streams and other special aquatic features to mitigate this risk.

Due to the very small quantity of upland treatment (2 acres) habitat effects are expected to be very minimal. Herbicide effects should be absent since none are proposed for use within 107 feet of suitable SNYLF habitat. No measureable change to habitat suitability is expected.

Foothill Yellow-legged Frog

Only Grapevine Creek has occupied FYLF habitat and the potential for direct effects from the proposed treatments. All other known occupied sites do not have proposed units within 100 feet of aquatic habitat. This analysis assumes that the vast majority of effects would originate due to activities within the 100-foot strip along streams; however, it is recognized that small quantities of sediment increase could originate from outside this area. Sediment analysis at a watershed scale is provided in the project watershed report.

This analysis uses a small (hydrologic unit code 7) watershed approach to estimate effects for all suitable habitat, with the assumption that these areas could theoretically become occupied over the project timeframe. Project activities within 100 feet of suitable habitat are quantified.

Table 3.03-6 shows that some sub-watersheds have a high percentage of habitat proposed for treatment, however, risk to individuals is substantially reduced due to project management requirements that prohibit most treatment near water. For example, heavy equipment would not operate near water (equipment exclusion zone) and existing riparian vegetation would be left intact. This species is highly aquatic and generally stays within a few feet of water, therefore treatment is unlikely to directly injure or kill individual frogs, though nearby activities may alter behavior (e.g., flee response). Presumably, those sub-watersheds with the highest percentage of treatment would have a correspondingly greater risk of creating behavioral disturbance.

The primary anticipated indirect effect is the increase of sediment delivery to the streams following reforestation actions. Heavy equipment use, such as tilling, would likely increase sediment yield in some areas (watershed report) for up to a few years, though the magnitude of potential increase is expected to be low. Removal or modification of vegetative cover through a variety of activities (e.g., mastication, herbicides, and prescribed fire) would also affect terrestrial habitat. Other cover types, such as rodent burrows, could also be modified by heavy equipment use. Most of this activity would occur in the middle and upper portion of the 100-foot buffer, which are areas less-utilized by the highly aquatic FYLF; therefore, the majority of utilized terrestrial habitat is likely to remain suitable.

Herbicide use poses risks to aquatic organisms, though observable direct effects to frogs are not expected and are below the threshold of concern (hazard quotient less than 1) (SERA risk assessments). Glyphosate (aquatic label) would be the herbicide used over the large majority of treated areas. As stated previously in the general effects discussion, it is possible that food organisms utilized by FYLF could be affected (directly or indirectly) if estimated concentrations (SERA risk assessments) were to occur. However, estimated concentrations do not consider project management requirements (2.02 Alternatives Considered In Detail) which would help mitigate potential indirect effects to aquatic organisms consumed by FYLF. Therefore, any effects would be spatially isolated and of low magnitude, with fast recovery likely.

Table 3.03-6 Alternative 1: Buffer Treatment in FYLF Suitable Habitat

Sub-watershed (HUC 7)	FYLF[1] Treated	REF/THIN[2] (acres)	WEED[3] (acres)
Ackerson Creek	<1	3	2
Bear Springs Creek-Lower Clavey River	10	44	6
Bull Meadow Creek-Lower Clavey River	24	107	68
Cherry Lake	38	108	<1
Clavey River	<1	2	0
Corral Creek	77	210	101
Cottonwood Creek	12	34	0
Deer Lick Creek	52	14	2
Granite Creek	48	209	142
Grapevine Creek	49	144	42
Gravel Range-Tuolumne River	10	46	34
Headwaters Upper North Fork Merced River	4	10	0
Hull Creek	<1	0	<1
Hunter Creek	33	120	4
Lower Eleanor Creek-6	0	0	0
Lower Jawbone Creek	27	75	14
Lower Middle Fork Tuolumne River East	44	193	19
Lower Middle Fork Tuolumne River West	34	207	47
Lower South Fork Tuolumne River East	12	212	19
Lower South Fork Tuolumne River West	19	108	1
Middle Fork Day Use (Upper Middle Fork Tuolumne River)	15	20	1
Middle Jawbone Creek	13	60	0
Moore Creek-Upper North Fork Merced River	36	13	11
North Crane Creek-Upper South Fork Tuolumne River	<1	1	0
Quilty Creek-Lower Clavey River	5	9	0
Reed Creek	32	144	141
Reynolds Creek	3	17	0
Two Mile Creek	2	7	0
Upper Bull Creek	38	6	0
Upper Jawbone Creek	27	134	30
Upper South Fork Tuolumne River West	1	6	0

THIN=Thin Existing Plantations; REF=Reforestation; WEED=Noxious Weed Eradication
[1] Percent of total 30 meter buffer treated within FYLF Sub-Watershed.
[2] FYLF Buffer Affected
[3] Most noxious weed populations overlap spatially with other treatment units.

Western pond turtle

The risk of direct effects to the western pond turtle (WPT) is higher than for the FYLF because the turtle uses the uplands more extensively during different times of the year. WPT can use upland habitats up to 400 meters away from an aquatic habitat and can occur in upland habitats for overwintering, nesting, and aestivation. In general, turtles remain close to water from early spring through early fall, but in habitats with seasonal water, they can move into upland habitat when the seasonal feature is dry. Table 3.03-7 provides a description of the amount of proposed treatment area overlapping WPT habitat.

Table 3.03-7 shows that some sub-watersheds have a high percentage of habitat area proposed for treatment, though the majority are not currently occupied by WPT. In areas where project units overlap with known occupied sites (e.g., Abernathy Meadow, Kibbie Ridge Ponds), risks to individuals is substantially reduced by species-specific project management requirements (Chapter 2.02).

Management requirements would provide some level of protection for known turtle populations, though direct effects could occur since this species commonly utilizes terrestrial habitat far from water. In addition, behavior could be affected by treatment activities. The risk is substantially higher in areas where the turtles are not known to occur due to more intensive treatment near suitable habitat. If turtles are present but not discovered prior to or during project implementation, it is likely that a portion of the localized population could be injured or killed by heavy equipment (e.g., from tilling, masticating) or prescribed fire. Turtles may overwinter in the upland from October through April, but heavy equipment use would be unlikely at this time of year due to machinery operational constraints associated with soil compaction risk. During June and July, the WPT could use the uplands for nesting, but the availability of nesting habitat is very limited and restricted to relatively open, herbaceous dominated slopes. The risk increases to moderate in October if ground-disturbing activities continue late into the year because the turtles move into the upland habitat as the weather gets colder. Though short-term (few years) habitat modification is expected, the level of potential impact at these locations would not be sufficient to affect the long-term viability of any existing population.

The primary anticipated indirect effect is the small increase of sediment delivery to water bodies following reforestation actions. Heavy equipment use, such as tilling, would likely increase sediment yield in some areas (watershed report) for a few years. Removal of vegetative cover through a variety of activities (e.g., mastication, herbicides, prescribed fire) would also affect terrestrial habitat. Other cover types could also be modified by heavy equipment use. Large woody debris (LWD), an important habitat component for WPT, is expected to be minimally affected, as nearly all modified or removed vegetation is expected to be of small diameter and not suitable for basking. Table 3.03-7 indicates the quantity of habitat modification likely to occur in each project sub-watershed (within 300-meter buffer).

Herbicide use poses risks to aquatic organisms, though observable direct effects to turtles are not expected and are below the threshold of concern (hazard quotient less than 1) (SERA risk assessments). Glyphosate (aquatic label) would be the herbicide used over the large majority of treated areas. As stated previously in the general effects discussion, it is possible that food organisms utilized by WPT could be affected (directly or indirectly) if estimated concentrations were to occur. However, estimated concentrations do not consider project management requirements (list above) which are likely to prevent or further reduce observable changes to food sources. Any potential effects would likely be short-term.

Table 3.03-7 Alternative 1: WPT Buffer Affected Units

Sub-watershed (HUC 7)	WPT[1] Treated	REF/THIN[2] (acres)	WEED[3] (acres)
Stream buffer			
Ackerson Creek	3	146	55
Basin Creek	1	5	0
Bear Springs Creek-Lower Clavey River	14	545	60
Bull Meadow Creek-Lower Clavey River	32	1152	550
Cherry Canyon-East Fork Cherry Creek	0	0	0
Cherry Lake	36	1168	1
Clavey River	1	30	0
Corral Creek	69	1781	841
Cottonwood Creek	13	334	15
Deer Lick Creek	32	147	10
Granite Creek	41	1167	614
Grapevine Creek	54	1505	72
Gravel Range-Tuolumne River	13	504	284
Headwaters Upper North Fork Merced River	8	170	1
Hull Creek	4	109	<1
Hunter Creek	31	1082	14
Kibbie Ridge-Lower Cherry Creek	<1	10	0
Lower Eleanor Creek-6	1	21	0
Lower Jawbone Creek	30	732	88
Lower Middle Fork Tuolumne River East	48	1898	118
Lower Middle Fork Tuolumne River West	36	1815	284
Lower South Fork Tuolumne River East	28	2314	75
Lower South Fork Tuolumne River West	23	1070	9
Middle Fork Day Use (Upper Middle Fork Tuolumne River)	21	247	21
Middle Jawbone Creek	17	534	9
Moore Creek-Upper North Fork Merced River	37	198	110
North Crane Creek-Upper South Fork Tuolumne River	1	36	0
Plum Flat-Lower Cherry Creek	<1	6	<1
Poopenaut Valley West	<1	12	0
Quilty Creek-Lower Clavey River	14	198	28
Reed Creek	36	1448	1019
Reynolds Creek	7	353	0
Sugarloaf-Tuolumne River	<1	5	23
Two Mile Creek	3	88	0
Upper Bull Creek	30	83	0
Upper Jawbone Creek	36	1622	127
Upper South Fork Tuolumne River West	1	41	0
Pond buffer			
Cherry Lake	3	34	0
Granite Creek	24	115	19
Kibbie Ridge-Lower Cherry Creek	2	11	0
Lower Eleanor Creek-6	1	24	0
Lower Jawbone Creek	0	1	0
Lower Middle Fork Tuolumne River East	12	56	1
Lower South Fork Tuolumne River East	26	59	18
Lower South Fork Tuolumne River West	2	8	0
Middle Fork Day Use (Upper Middle Fork Tuolumne River)	28	17	5
Middle Jawbone Creek	9	80	<1
Reynolds Creek	6	9	0
Upper Jawbone Creek	16	165	14

THIN=Thin Existing Plantations; REF=Reforestation; WEED=Noxious Weed Eradication

[1] Percent of 300-meter (984 feet) buffer treated

[2] WPT Buffer Affected

[3] Most noxious weed populations overlap spatially with other treatment units.

Hardhead

Because very few proposed treatment units are within close proximity to suitable habitat no direct effects would occur to hardhead.

The indirect effect to hardhead is only related to sediment. Because a very small portion (less than 3%) of the North Fork Tuolumne River watershed burned at moderate severity (no high severity soil burn conditions), there would be no observable change to habitat conditions in the lower river. Because the Tuolumne River does not provide suitable breeding habitat for the hardhead (due to regulated streamflow), no indirect impacts on spawning habitat suitability would occur. Localized accumulations of sediment near the mouths of tributary streams that had a high proportion of high and moderate severity fire, but the sediment from all watershed sources (including the proposed project) would not be sufficient to have much of an effect on pool and deep run habitats.

CUMULATIVE EFFECTS

The primary pathways considered for cumulative effects to the CRLF and SNYLF are; 1) the potential risk of directly impacting individuals or their habitats, and 2) the risk of increased sedimentation in the habitats.

The Cumulative Watershed Effects analysis for the project provides a general view of treatment effects as compared to the total from this project and all other actions listed in Appendix B. Calculations for five sub-watersheds (7^{th} field HUC) indicated that total effects, expressed as Equivalent Roaded Acres (ERA), are highly variable. In the first few years of treatment, Alternative one would likely contribute between 10 to 50% of total effects, depending on sub-watershed.

Vegetation management on private lands and livestock grazing were the two types of cumulative effect stressors evaluated for the FYLF, WPT, and hardhead. These two types of actions are considered to have the most detectable influence on aquatic systems, especially in the post-fire environment. The impact of post-fire logging was discussed earlier in this document and this activity has the highest potential to increase erosion and sedimentation rates in a watershed. Livestock grazing is also discussed because the impact of concentrated livestock use in riparian areas (made more sensitive by moderate and high soil burn severity conditions) may have localized impacts to streambanks and the reestablishment of riparian vegetation.

Livestock grazing as a cumulative stressor is discussed at a general level, due to seasonal/annual difference in utilization. Livestock may be excluded, partially or fully, from some allotments within the Rim Fire perimeter in the next few years. Assuming the Forest Service allows light levels of grazing in portions of the allotments, livestock could impact sensitive streambanks through trampling. Streambanks are more sensitive post-fire than in unburned conditions because much of the vegetation has been burned and there is little root holding capacity to resist shearing by hooves. This is especially true in low gradient reaches (less than 2%) where alluvial (or depositional) banks dominate. In steeper gradient reaches, the streambanks tend to be more armored by larger diameter substrates (rocks like cobble and boulder) and resistant to bank shear. These localized areas of streambank disturbance may not have much of an effect at larger watershed scales, but they can influence sedimentation at locally important scales. If livestock are allowed to graze portions of the allotments, a small increase in sedimentation would be expected along low gradient reaches with no discernible increase along higher gradient sections. However, any impact in watersheds with high levels of project actions (e.g., greater than 25% of FYLF and WPT buffer) could cumulatively contribute to degradation of aquatic habitat. The duration of this combined reduction in habitat suitability would be two to three years. After this period, hillslope erosion rates would quickly decrease and habitat suitability would increase to moderate levels.

Another impact associated with livestock is the potential impaired recovery of riparian vegetation because livestock can affect the recovery of obligate woody and herbaceous riparian species. The rapidly re-growing riparian vegetation is always a good food source, but especially late in the season when other forage options may have decreased in palatability. The proximity of this forage to water, another critical resource need for livestock, suggests livestock may congregate in sensitive post-fire riparian areas. Project activities are not expected to affect riparian vegetation, so very little cumulative effect to riparian recovery is expected.

California Red-legged Frog

Approximately 50% (about 2,000 acres) of available CRLF habitat is located within grazing allotments. This analysis assumes that grazing could occur within all allotments.

Livestock grazing in close proximity to streams has the potential to impact streambank stability through trampling and chiseling of the banks by cow hooves. Overall, the effect of livestock grazing relative to sedimentation is considered to be minor and is expected to recur on an annual basis. The minor amount of sediment attributable to grazing would potentially combine with sediment associated with implementation of this project. Combined, the sediment could impact slow water habitats and may be observable as a light dusting of silt in slow water habitats or small pockets of fine sands accruing behind larger stream substrates (cobbles and boulders) and in the slowest velocity areas of pools. This type of sediment impact is not expected to significantly reduce pool volume or the spaces between streambed substrates where individuals could seek refuge from predation. This type of sedimentation pattern would not impair foraging habitat for tadpoles to the extent that growth and development are impacted.

Livestock grazing could also limit the regrowth of obligate riparian species (e.g., willows, alders, aspen) that were impacted by the fire. If the fire effectively killed the above ground portions of these types of riparian vegetation, the plant responds by sending up new growth from the roots or root crown. These new shoots capitalize on the extensive root system that was developed by the plant by growing rapidly and re-establishing riparian cover in the long-term. Cattle do browse this new growth because it is very nutritive, but they tend to preferentially graze these plants late in the season when other upland forage (especially sedges) has lost its nutritional value. If the livestock greatly reduce the amount of regrowing vegetation, the shading and leaf fall provided by these plants would be reduced. The CRLF can be found in full sun habitats, but a mix of shaded conditions allows the animal to effectively control body temperature while not moving great distances to find a satisfactory resting place. The annual leaf fall by obligate riparian plants also provides a beneficial resource to streams through nutrients dissolved in the water and organic matter added to the stream. Primary productivity, the growth of algae and other biological films forming on streambed substrates, is greatly influenced by the nutrients dissolved from the leaves. These biological films are very important food sources for the frog at the tadpole stage since they are algal grazers. The organic material provided by the leaves is also used by many species of aquatic insects that either ingest portions of the leaves or use the leaves in other ways (for example, caddisfly cases). The adult forms of these aquatic insects are seasonally important food sources for post-metamorphic frogs. Excessive impacts to regrowing riparian vegetation would have moderate impacts on stream shading in the short- to mid-term (3 to 10 years) and a very minor impact on aquatic insect and primary productivity.

Other federal actions could impact about 78 additional acres, only a few acres located adjacent to water. As compared to the project and grazing impacts, this additional disturbance would be very minor.

In the Hunter Creek habitat unit, private lands are present to the north and east. The majority of these lands are located away from water. Timber harvest and other ground-disturbing activities could contribute to project effects through vegetation removal and sediment increase, but are unlikely to contribute substantial effects due to the relatively small percentage of total habitat affected.

Sierra Nevada Yellow-legged Frog

Ground disturbance from implementation of the Rim Fire Reforestation Project is expected to occur adjacent to the Kibbie Ridge ponds. Project management requirements are expected to minimize habitat effects near aquatic habitat, and would roughly equate to those effects expected from this project. No other actions were identified within these areas that could contribute to cumulative effects.

The small area of stream (about 0.5 miles) habitat potentially affected by the project is located within a grazing allotment. Grazing could contribute cumulatively to sediment input and riparian vegetation disturbance, see previous discussion for CRLF. Compared to the project, grazing could produce a higher quantity of effects to water since livestock are not excluded from the stream. However, cumulative impacts are likely to be inconsequential due to the very small section of stream potentially affected, and the very low likelihood of species presence.

Private lands are not present near SNYLF habitat, so no cumulative effects are expected from this source. Yosemite National Park is located just east of suitable habitat, and no known contributing actions are proposed in these areas.

Foothill Yellow-legged Frog

Nearly all FYLF habitat areas are located within grazing allotments, though only certain portions of allotments are actually utilized by livestock. In comparison, the project could affect up to 16% of available habitat, see previous discussion for CRLF, and poses some risk to individual frogs from trampling.

All other known future actions would only impact about 14 additional acres of habitat, which is inconsequential as compared to the project and grazing effects.

Four sub-watersheds have substantial private lands near FYLF habitat that have the potential to contribute to effects, including: Reed Creek, Granite Creek, Lower Jawbone Creek, and Middle Jawbone Creek. Ground disturbing activity could cumulatively contribute to project sediment and affect FYLF habitat.

Western Pond Turtle

The discussion of cumulative effects to stream habitat for amphibians applies to the WPT because they use similar habitats. The main difference is that the WPT is less likely to utilize the very small, intermittent streams where sedimentation effects would be the highest.

As with FYLF, the majority of WPT habitat is contained within grazing allotments and would be subject to effects described for CRLF. In addition to habitat effects, trampling is also possible, but would likely only affect a very small percentage of individuals.

Other action types account for about 500 acres, the majority of which are timber management. This area is only about 2% of the total (project plus other actions excluding grazing). The small additional contribution would produce proportional effects similar to the proposed actions.

Four sub-watersheds have substantial private lands near WPT habitat that have the potential to contribute to effects, including: Reed Creek, Granite Creek, Lower Jawbone Creek, and Middle Jawbone Creek. Ground disturbing activity could cumulatively contribute to project sediment and negatively affect WPT habitat.

Hardhead

Very little watershed area would be affected by cumulative actions and the sediment generated from those actions would not be readily detectable in suitable hardhead habitat. The Clavey and Tuolumne Rivers are so large and have such high capacity to transport and store fine sediment that the deep water habitats would be minimally impacted and deep water refuge would be maintained. The sediments that could accumulate in spawning habitats would not be likely to impair spawning success in the Clavey River.

Alternative 2 (No Action)

Direct and Indirect Effects

General Effects Common to All Species

No direct effect would be expected under Alternative 2. There would be no potential for mortality, injury, or physical disturbance of any of the three Forest Service Sensitive species created by reforestation actions.

Because the Forest Service would take no action under this alternative, natural watershed recovery processes would occur. Over time, there would be a gradual reduction in the delivery of sediment to stream channels as fire-resilient plant species recolonize burned areas and the soil-repellent layers break up. Erosion rates for most of the burned area would approach pre-fire rates within 5 or 6 years, but some areas could have elevated rates for up to 10 years. Streamflows would continue to be higher than in the pre-fire condition and some of the mapped intermittent streams could support perennial flow or maintain perennial water in pool habitats for 20 years or more. With the increased streamflow and decreased erosion (and sediment delivery to streams) rates, the silt and sand deposited and stored in the stream channels would be largely scoured from the channels within 5 to 7 years and pre-fire streambed condition would be evident in 10 years.

Stream shading would increase in riparian areas affected by moderate and high vegetation severity fire. The obligate woody riparian species would regrow from stems and root crowns and increase in density via dispersal of seeds along the streams. Over the next 20 years, shading would increase to the point where cool and cold water temperatures would be maintained.

Compared to the project alternatives, the growth rate and distribution of trees would be reduced due to increased competition from other vegetation (e.g., shrubs). Sediment mobilization would likely be less in the short- term (absence of heavy equipment use) and similar in the long-term. Long-term LWD recruitment from trees would be reduced due to a lengthier period of time needed to establish larger trees. Herbicide effects would be absent.

California Red-legged Frog, Sierra Nevada Yellow-legged Frog, Foothill Yellow-legged frog, Western Pond Turtle, and Hardhead

Under this alternative no direct or indirect effects would occur to individuals as a result of project activities. Vegetation recovery would continue at natural/variable rates, and noxious weeds would presumably continue to increase. Sediment input to aquatic habitats would continue to decrease as vegetation recovery progresses.

Cumulative Effects

Due to the absence of direct and indirect effects, no cumulative effects would occur.

Alternative 3

Direct and Indirect Effects

Under this alternative, herbicides would not be utilized, resulting in an approximate 40% reduction in acres proposed for noxious weed eradication. In addition, reforestation units would experience an increase in soil-disturbing methods (nearly double) due to the elimination of glyphosate. See 2.02 Alternatives Considered in Detail for a detailed description of this alternative.

California Red-legged Frog

Less than 10 acres of noxious weed treatment units within CRLF habitat would occur under Alternative 3, where manual methods would be used instead of herbicides. Essentially no impact would be expected from this very small change. The majority of other proposed actions (about 4,000 acres) within CRLF habitat would be treated with mechanical or hand methods rather than glyphosate. Non-herbicide methods disturb soil, and would likely lead to an increase in erosion and subsequent sediment increase to the aquatic environment.

The absence of herbicide use would eliminate the possibility of chemical contamination and associated indirect effects to suitable CRLF aquatic and terrestrial habitat.

Sierra Nevada Yellow-legged Frog

Same as Alternative 1 since no herbicides are proposed within 107 feet of SNYLF habitat in Alternative 1.

Foothill Yellow-legged Frog

Within FYLF habitat buffers, Alternative 3 would result in approximately 75% fewer noxious weed treatment acres (142) as compared to Alternative 1. Mechanical or hand methods would also be used in reforestation units, about 2,300 acres. Non-herbicide methods disturb soil, and would likely lead to increased erosion and subsequent sediment within aquatic habitats. The absence of herbicide use would eliminate the possibility of chemical contamination and associated indirect effect to frogs within suitable aquatic and terrestrial habitat.

Western Pond Turtle

Alternative 3 would result in an approximate 75% reduction in noxious weed units as compared to Alternative 1. In the remaining noxious weed units, about 1,500 acres, use of mechanical or hand methods is proposed rather than glyphosate. Use of mechanical or hand methods are also proposed in all other units (e.g., reforestation, natural regeneration) within WPT habitat. Non-herbicide methods disturb soil, and would likely lead to an increase in erosion and subsequent sediment increase to the aquatic environment. The project watershed report describes this difference. Since turtles extensively utilize the terrestrial environment, direct effects to turtles, such as injury or death from heavy equipment, would be substantially increased when compared to Alternative 1.

The absence of herbicide use would eliminate the possibility of chemical contamination and associated indirect effects (e.g., food sources) to turtles within suitable aquatic and terrestrial habitat.

Hardhead

Same as Alternative 1.

Cumulative Effects

California Red-legged Frog

Sediment delivery would differ between Alternatives 1 and 3 due to the increased ground disturbance from Alternative 3. Cumulative Watershed Effects analysis indicates this alternative is likely to produce more sediment effects (as inferred from ERAs) than any other Alternative. Since this species is almost certainly absent from the project area, this effect combined with those of other actions would be of little consequence. Habitat suitability would be minimally affected, and sediment input would likely return to natural levels within a few years post-project.

Sierra Nevada Yellow-legged Frog

Same as Alternative 1.

Foothill Yellow-legged Frog

Increased ground disturbance from Alternative 3 combined with those of other adjacent actions, particularly in the four sub-watersheds that also have private lands within and nearby, would be greater under Alternative 3. Sediment input would return to natural or background levels in the longer term.

Western Pond Turtle

Increased ground disturbance from Alternative 3 combined with those of other adjacent actions, particularly in the four sub-watersheds that also have private lands within or nearby, would be greater under Alternative 3. Individual turtles would be more susceptible to direct harm from increased heavy equipment use. Sediment input would return to natural or background levels in the longer term.

Hardhead

Same as Alternative 1.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Alternative 4 proposes the same noxious weed treatments as Alternative 3, which includes reduced acreage and no herbicides. As with Alternative 3, in other units sediment input could increase due to increased use of soil-disturbing treatment methods. Alternative 4 proposes an approximate 85% reduction in reforestation units. Prescribed fire would be used extensively under this Alternative.

California Red-legged Frog

Under Alternative 4 there would be an approximate 90% reduction in treatment units within CRLF habitat as compared to Alternative 1. This would substantially reduce the quantity of vegetation disturbance and sediment production, as well as potential effects from herbicide (glyphosate only) that would still be used in the remaining acres. Increased fire use could reduce sediment input somewhat compared to mechanical methods (e.g., deep tilling), as this method generally produces little soil disturbance. This alternative would likely produce the least effects to CRLF habitat of any action alternative (1, 3, 4, and 5).

Sierra Nevada Yellow-legged Frog

Under Alternative 4 there is no treatment proposed near potential habitat; therefore no effects would be expected.

Foothill Yellow-legged Frog

Under Alternative 4 there would be an approximate 75% reduction in treatment units, including noxious weed units, as compared to Alternative 1. This would substantially reduce the quantity of vegetation disturbance and sediment production, as well as potential effects from herbicide (glyphosate only) that would still be used in the remaining acres. Increased fire use could reduce sediment input somewhat compared to mechanical methods (e.g., deep tilling), as this method generally produces little soil disturbance. This alternative would produce the least effects to FYLF habitat of any action alternative (1, 3, 4, and 5). Due to their close association with water, it is likely that there would be little difference in direct effects to individuals; both fire and mechanical methods would initiate a flee response into water or near-shore cover that is unlikely to be affected.

Western Pond Turtle

Similar to FYLF, under Alternative 4 there would be an approximate 75% reduction in treatment units, including noxious weed units, as compared to Alternative 1. This would substantially reduce the quantity of vegetation disturbance and sediment production, as well as potential effects from herbicide (glyphosate only) that would still be used in the remaining acres. Increased fire use could reduce sediment input somewhat compared to mechanical methods (e.g., deep tilling), as this method generally produces little soil disturbance. This alternative would produce the least effects to WPT habitat of any action alternative (1, 3, 4 and 5). Both fire and mechanical methods would pose a risk to individual turtles, though the reduced acreage of this Alternative would reduce risk compared to the other action alternatives.

Hardhead

Same as Alternative 1.

CUMULATIVE EFFECTS

California Red-legged Frog

Cumulative effects similar to Alternative 3 in type, but moderately reduced due to lower acreage treated. Though herbicides are proposed for reforestation treatments, the acreage is considerably reduced and potential indirect effects would be minimized.

Sierra Nevada Yellow-legged Frog

There are no direct or indirect effects; therefore no cumulative effects would occur.

Foothill Yellow-legged Frog

Cumulative effects similar to Alternative 3 in type, but moderately reduced due to lower acreage treated. Though herbicides are proposed for reforestation units, the acreage is considerably reduced and potential indirect effects would be minimized.

Western Pond Turtle

Cumulative effects similar to Alternative 3 in type, but moderately reduced due to lower acreage treated. Though herbicides are proposed for reforestation units, the acreage is considerably reduced and potential indirect effects would be minimized.

Hardhead

Same as Alternative 1.

Alternative 5

DIRECT AND INDIRECT EFFECTS

Alternative 5 actions and effects are similar to those discussed under Alternative 1. The difference is that the 4,031 acres of natural regeneration areas would be planted immediately under this alternative instead of waiting to monitor for 5 years. Therefore a relatively small increase in all effects associated with reforestation activities discussed under Alternative 1 could occur.

California Red-legged Frog

Small increase in all potential effects described for Alternative 1.

Sierra Nevada Yellow-legged Frog

Small increase in all potential effects described for Alternative 1.

Foothill Yellow-legged Frog

Small increase in all potential effects described for Alternative 1.

Western Pond Turtle

Small increase in all potential effects described for Alternative 1.

Hardhead

Same as Alternative 1.

CUMULATIVE EFFECTS

California Red-legged Frog

Cumulative effects similar to Alternative 1 in type and magnitude, but slightly increased due to larger quantity of reforestation.

Sierra Nevada Yellow-legged Frog

Cumulative effects similar to Alternative 1 in type and magnitude, but slightly increased due to larger quantity of reforestation.

Foothill Yellow-legged Frog

Cumulative effects similar to Alternative 1 in type and magnitude, but slightly increased due to larger quantity of reforestation.

Western Pond Turtle

Cumulative effects similar to Alternative 1 in type and magnitude, but slightly increased due to larger quantity of reforestation.

Hardhead

Same as Alternative 1.

Summary of Effects Analysis across All Alternatives

California Red-legged Frog

The implementation Alternatives 1, 3 and 5 all pose similar risk to individual CRLF and their habitats although the risk is low. Though herbicide exposure would be eliminated under Alternative 3, increased ground disturbance and resulting sediment increase could occur. Upland habitats have the greatest proportion of overlap with project activities, where vegetation modification or loss would occur. The risk to CRLF and their habitats is lowest under Alternative 4 due to a large decrease in the project footprint within suitable habitat.

Possible direct effects to individuals include injury, mortality, or behavioral disturbance. For all Alternatives, the direct effects to aquatic habitats are minimized by management requirements prohibiting operations within and adjacent to aquatic features. The upland habitat would be at a greater risk of direct effects from change or loss of near-ground vegetation cover. A limited operating period in conjunction with other management requirements should mitigate these risks.

A potential increase of sediment depth in breeding and non-breeding habitat is the most likely effect to CRLF habitats. Sediment potential is somewhat higher for Alternatives 3 and 5 as compared to 1, and substantially less for Alternative 4.

Sierra Nevada Yellow-legged Frog

Similar to the CRLF, the implementation of Alternatives 1, 3 and 5 pose the greatest risk to individual SNYLF and their habitats although the risk is low, and little difference exists between the action alternatives due to the very small quantity of available habitat within the project area. Alternative 4 would not affect this species.

Possible direct effects to individuals include injury, mortality, or behavioral disturbance. Direct effects to aquatic habitats are not expected to occur because management requirements prohibit operations within and adjacent to aquatic features. The upland habitat would be at greater risk of direct effects in comparison to the breeding and non-breeding aquatic habitats, although in comparison to CRLF, the upland habitat of SNYLF are less important to their overall survival because of their close affinity to water and the lack of habitats in close enough proximity to one another to elicit overland movements.

A potential increase of sediment depth in breeding and non-breeding habitat is the most likely effect SNYLF habitats may experience, but the effects of implementing the actions proposed under Alternatives 1, 3 and 5 are negligible to minor in comparison to the increases in sediment from the effects of the Rim Fire.

DETERMINATIONS FOR THE CALIFORNIA RED-LEGGED FROG AND SIERRA NEVADA YELLOW-LEGGED FROG

The following determination is supported by the analysis contained in this EIS. The overall project "may affect, likely to adversely affect" California red-legged frog and Sierra Nevada yellow-legged frog. The determination of "may affect, likely to adversely affect" for California red-legged frog is limited to 7 locales. These are Drew Creek, Hunter Creek and ponds or impoundments on streams (Birch Lake, Mud Lake, Homestead Pond, Harden Flat ponds, Hunter Creek area ponds.) For the Sierra Nevada yellow-legged frog, this determination is applicable to two analysis areas: Big and Little Kibbie Ponds, and the Middle Fork Tuolumne River near the Yosemite National Park boundary. Because occupancy is assumed at these locations (except Big and Little Kibbie Ponds), there is the potential for project activities to directly impact individuals occurring in aquatic or upland habitats. The most likely direct impact is physical disturbance resulting from forest workers and equipment. Through multiple reforestation actions, the project would modify the upland habitat by reducing the availability of vegetation cover and large woody debris. These effects apply to both species in most cases. There are some differences between action alternatives 1, 3 and 5 in terms of extent and intensity of impact, though the determination for California red-legged frog is still "may affect, likely to adversely affect" for Alternatives 1, 3, 4 and 5. However due to the absence of treatment in SNYLF habitat under Alternative 4, the determination is "No affect", and "may affect, likely to adversely affect" for Alternatives 1, 3 and 5.

For the No Action alternative, there would be no project-related effects to the California red-legged frog and Sierra Nevada yellow-legged frog.

Foothill Yellow-legged Frog

The implementation Alternatives 1, 3 and 5 all pose similar risk to individual FYLF and their habitats although the risk is low since this species tends to reside very close to water, where project activity would generally not occur. Possible direct effects to individuals include injury, mortality, or behavioral disturbance.

Though herbicide exposure would be eliminated under Alternative 3, increased ground disturbance and resulting sediment increase could occur. Upland habitats have the greatest proportion of overlap with project activities, where vegetation modification or loss would occur, though this should minimally affect the highly aquatic FYLF. The risk to FYLF habitats is lowest under Alternative 4 due to a large decrease in the project footprint within suitable habitat. A potential increase of sediment depth in breeding and non-breeding habitat is the most likely effect to FYLF habitats. Sediment potential is somewhat higher for Alternatives 3 and 5 as compared to 1, and substantially less for Alternative 4.

For all Alternatives, the direct effects to aquatic habitats are minimized by management requirements prohibiting operations within and adjacent to aquatic features, and if the species is known to be present. A limited operating period in conjunction with other management requirements should mitigate the above risks.

Western Pond Turtle

The implementation Alternatives 1, 3, and 5 all pose similar risk to individual WPT and their habitats. The increase in ground disturbance under Alternative 3 could expose more individual frogs to direct effects, but protective project management requirements are in place for occupied sites. Possible direct effects to individuals include injury, mortality, or behavioral disturbance. Alternative 4 would pose the lowest risk to individuals due to a substantial reduction of the project footprint.

Though herbicide exposure would be eliminated under Alternative 3, increased ground disturbance and resulting sediment increase could occur. This species is susceptible to increased heavy equipment use since it commonly utilizes terrestrial habitat. The risk to WPT and their habitats is lowest under Alternative 4 due to a large decrease in the project footprint within suitable habitat. Upland habitats have the greatest proportion of overlap with project activities, where vegetation modification or loss would occur. A potential increase of sediment depth in breeding and non-breeding habitat is the most likely effect to WPT habitats. Sediment potential is somewhat higher for Alternatives 3 and 5 as compared to 1, and substantially less for Alternative 4.

For all Alternatives, the direct effects to individuals and aquatic habitats are minimized by management requirements prohibiting operations within and adjacent to aquatic features and due to additional protective measures where the species is known to be present.

Hardhead

No measurable differences exist between effects to hardhead or their habitats. High suitability habitat for all life stages would be maintained in the lower North Fork Tuolumne and Clavey Rivers and habitat for adult and sub-adult life stages would not be measurably affected by any or all actions.

DETERMINATIONS FOR THE SENSITIVE SPECIES

A determination of "may affect individuals, but is not likely to lead to a trend in federal listing or loss of viability" was made for the foothill yellow-legged frog, western pond turtle, and hardhead and are supported by the analysis contained in this EIS. For the foothill yellow-legged frog and western pond turtle, this determination was based on the potential for direct effects to individuals and indirect effects to habitats to occur as a result of project activities. The primary anticipated impact to individuals is physical disturbance and the primary anticipated impact to habitat is sedimentation of aquatic habitat. When combined with post-fire effects to habitat and individuals and watershed level impacts from cumulative actions, some localized populations could have reductions in numbers. However, these two species are expected to occur within watersheds affected by the proposed actions and are well distributed across the forest and throughout their ranges. For the hardhead, slight impacts to habitat are anticipated because of sediment delivery to aquatic habitats, but the habitats they rely upon would remain available and capable of supporting all life history requirements.

The determination applies to all four action alternatives because some level of impact, even if very small, could occur to individuals and aquatic and upland habitats at most locations.

For the No Action alternative, there would be no project related effects to foothill yellow-legged frogs, western pond turtles, or hardhead.

3.04 Cultural Resources

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

Several laws direct the Forest Service to identify, evaluate, treat, protect and manage cultural resources. The National Historic Preservation Act (NHPA) as amended (16 U.S.C. 470 et seq.) provides comprehensive direction to federal agencies regarding historic preservation. Executive Order 11593, entitled *Protection and Enhancement of the Cultural Environment*, also includes direction about the identification and consideration of cultural resources in federal land management decisions.

The NHPA extends the policy in the Historic Sites Act of 1935 (49 Stat. 666; 16 U.S.C. 461-467) to include resources that are of State and local significance, expands the National Register of Historic Places (NRHP), and establishes the Advisory Council on Historic Preservation (ACHP) and State Historic Preservation Officers. NHPA Section 106 directs all federal agencies to take into account effects of their undertakings (actions, financial support, and authorizations) on properties included in or eligible for the NRHP. The ACHP regulations (36 CFR 800) implements NHPA Section 106. NHPA Section 110 sets inventory, nomination, protection, and preservation responsibilities for Federally-owned cultural resources.

Section 106 of the NHPA and the ACHPs implementing regulations, *Protection of Historic Properties* (36 CFR Part 800), require that federal agencies take into account the effect of their undertakings on cultural resources, and that agencies provide the ACHP with an opportunity to comment on those undertakings. Programmatic agreements (36 CFR 800.14(b)) provide alternative procedures for complying with 36 CFR 800.

The Stanislaus National Forest developed a specialized agreement: "Programmatic Agreement Among the United States Forest Service, Stanislaus National Forest, The California State Historic Preservation Officer, and the Advisory Council on Historic Preservation, Regarding the Compliance with the National Historic Preservation Act for Proposed Actions Pertaining to the Rim Fire Emergency Recovery Undertaking Programmatic Agreement (Rim PA, project record)." This agreement defines the Area of Potential Effects (APE) (36 CFR 800.4(a)(1)) and includes a strategy outlining the requirements for cultural resource inventory, evaluation of cultural resources, and effect determinations; it also includes protection and resource management measures that may be used where effects may occur. Additionally, this agreement provides unique and necessary opportunities to remove both non-commercial timber and hazard trees from within site boundaries utilizing a variety of harvest methods including one-end suspension and rubber tired machinery. Removal of these trees benefits the long term recovery and preservation of cultural resource sites by reducing future fuel build-up and fire weakened trees that could fall and impact already fragile resources.

Executive Order 11593: *Protection and Enhancement of the Cultural Environment*, issued May 13, 1971, directs Federal agencies to inventory cultural resources under their jurisdiction, to nominate to the NRHP all Federally owned properties that meet the criteria, to use due caution until the inventory and nomination processes are completed, and to assure that Federal plans and programs contribute to preservation and enhancement of non-Federally owned properties.

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

Assumptions Specific to Cultural Resources

- Site preparation including deep tilling, forest cultivation, mastication (shredding) and machine piling and burning will occur outside of cultural resource boundaries and thereby have no adverse effect to cultural resources.
- Hand or direct application of herbicides to noxious weeds within cultural resource site boundaries are not anticipated to have any adverse effects on cultural values, particularly plant species important to California Indian Basketweavers or other Native American gatherers.
- Prescribed burning to treat noxious weed areas will enhance and promote growth of native plant species.
- Removal of smaller diameter non-commercial timber (biomass) and standing dead trees within and adjacent to cultural resources through limited mechanical and hand cutting methods will have no adverse effect to cultural resources.
- All slash, brush, and other vegetation removed from within and outside of cultural resource site boundaries will be piled and burned outside of site boundaries thereby having no adverse effect to cultural resources.
- Removal of smaller diameter timber and standing dead trees from within site boundaries can have a beneficial effect on cultural resources. Removal of these trees would lessen the potential for damage to historic earthworks such as ditches, road, trails, and railroad grades (as they fall over time). Additionally, removal of this material would lessen fuel buildup that could potentially damage already fragile bedrock mortar outcrops.
- Use of existing breaches within linear sites, such as historic railroad grades, trails, roads and ditches, to access reforestation treatment units will cause no adverse effect to cultural resources.
- Use of existing water sources are not anticipated to affect cultural resources.
- According to the Rim PA (project record), all archaeological and historical sites identified within the APE for all alternatives are considered cultural resources for the purposes of this undertaking, unless they already have been determined not eligible in consultation with the SHPO or through other agreed on procedures (36 CFR 60.4; 36 CFR 800).
- Activities outlined within the EIS, when combined with the past, present and foreseeable future actions are not expected to cumulatively lead to increased impacts to cultural resources.

Data Sources

- Site specific cultural resource inventories conducted between 1986 to present (which meet current archaeological survey standards) were utilized. The primary objectives of these surveys were to identify cultural resources in the APE that may be affected by the undertaking and collect information on their current condition.
- Existing information from cultural resource records, historic archives, maps, and GIS spatial layers were also used.

Cultural Resources Indicators

Indicators of direct and indirect effects include:

- Exposure of surface and subsurface artifacts through deep tilling, forest cultivation, mastication (shredding) and machine piling.
- The degree to which the integrity of historic property values are diminished.

Cultural Resources Methodology by Action

The 2013 Rim Fire, while destructive, also provided the rare opportunity to have an unimpeded view of the forest floor. Utilizing previous archaeological inventories from past projects that meet current survey standards (1986 to present) in addition to the recently completed 12,685 acre survey for the

Rim Fire Recovery EIS (USDA 2014), nearly 78% of the proposed treatment areas were eliminated from further inventory. Continuing with the strategy developed for the Rim Recovery project, reforestation areas that fell outside of Recovery treatment units were intensively surveyed utilizing a 49 to 98-foot (15 to 30-meter) interval spacing. The strategy is consistent with both the 2013 Regional PA and the 2014 Rim PA (project record).

Affected Environment

Cultural resources are archaeological, cultural, and historical legacies from our past that are more than 50 years old. Cultural resource information, combined with environmental data, can illuminate past relationships between people and the land. Cultural-ecological relationships, the result of both natural processes and 10,000 years of human interaction in the central Sierra Nevada, are key topics in this region’s anthropological, archaeological, and historical research.

The Stanislaus National Forest currently contains 5,135 recorded prehistoric and historic archaeological sites (cultural resources). The vast majority of these (3,003) represent prehistoric Native Americans and ethnographic Miwok and Washoe land use. These include seasonal villages, temporary camps, toolstone quarries, and bedrock mortar milling locations. Today, the Miwok still actively use the Forest for gathering traditional food and medicine plants, hunting, and conducting ceremonies.

The project area contains 1,789 recorded sites of historic land use. These include emigrant trails, historic cabins, roads, bridges, lumber or mining complexes and camps, ditches, homesteads, grazing camps, arborglyphs (tree carvings), railroad grades, trestles, mining shafts and adits, and Forest Service administrative buildings and compounds. All of the historic sites found in the Forest, date from 1846 to the present.

Since people today favor many of the areas preferred by Native people, 343 sites have both a prehistoric and historic component.

Existing Conditions

This project encompasses the Forest’s second largest Section 106 compliance project in relation to a catastrophic wildfire event. The scale of the undertaking requires that an extensive field survey be conducted to identify cultural resources within the APE that may be affected by the various projects proposed under the post fire reforestation undertaking.

The Rim Reforestation project identifies 21,300 acres for reforestation (including mechanical site preparation, manual (hand) grubbing, herbicide treatments and prescribed fire), with an additional 3,833 acres of deer habitat enhancement, 12,769 acres of pre-existing plantation thinning, 608 acres of noxious weed treatment and 4,031 acres of natural regeneration treatments. These 42,541 acres constitute the Rim Reforestation project APE used in the environmental consequences analysis. A pre-field review determined that 27,218 acres of the APE had been previously surveyed for cultural resources through various other projects. The result of these surveys identified 1,995 prehistoric and historic properties within the project boundary of which 921 are located within or adjacent to treatment units likely to be affected by this project.

Of these 921 properties, 344 are prehistoric sites related to food processing (bedrock milling features), stone tool processing (lithic scatters) and temporary living areas (rock shelters). These sites are associated to land use by the native inhabitants of the region, known as the Central Sierra Miwok. Additionally, 501 historic sites are related to railroad logging (camps, grades and associated features), mining (mines, hydraulic mining areas, water conveyance ditches), water development (dams and water conveyance ditches), grazing (structures and fence lines) and homesteading (structure remains). Also, 76 sites are multi-component (both prehistoric and historic) sites. The remaining sites are noted but not recorded through previous undertakings and will be documented prior to implementation.

Heritage Resource Specialists identified the remaining 11,892 acres as needing archaeological survey in order to ensure the protection and preservation of cultural resources. This survey will be completed prior to project implementation as stipulated in the Rim PA (project record).

CONTEMPORARY NATIVE AMERICAN USE

From the onset of the Rim Fire and continuing through the Rim Recovery and Rim Reforestation efforts, the Forest Archaeologist consulted with the Tuolumne Band of Me-Wuk Indians regarding protection of traditional collection areas and sites significant to the Miwok people. Native peoples continue to utilize the area for traditional gathering and will continue to do so.

HISTORIC USE

Historic records, maps and oral accounts encompassing the project boundary indicate intensive land use since the Gold Rush era (1849) especially in the areas of mining, water development, railroad logging, and ranching. Numerous mines were located along the Eastern Belt, a zone of auriferous quartz veins in black slate or grandodiorite which ran parallel and east of the Mother Lode. Gold was also extracted from the Tertiary alluvial gravels with the development of hydraulic mining through 1884. In order to supply the mines and associated communities of Big Oak Flat and Second Garotte with sufficient water, a system of ditches and flumes was built by the Golden Rock Water Company in the late 1850s to distribute water from the Middle and South Fork Tuolumne Rivers. Remnants of the Golden Rock Ditch system, and other lesser known systems, run through many parts of the Rim Fire burn area. One of the Golden Rock's major engineering feats, the Inverted Syphon and the Big Gap Flume, is listed on the NRHP.

During the first three decades of the last century, four major railroad logging systems were built into the Tuolumne and Merced River drainage basins: West Side Lumber Company (1899); Yosemite / Sugar Pine Lumber Company (1907); Hetch Hetchy Railroad (established 1917) and the associated railroad logging operation; and California Peach and Fig Growers (1917), extending from Hetch Hetchy Junction (5 miles southwest of Chinese Camp) to Hetch Hetchy Valley. The Rim Fire affected portions of all four railroad logging systems to various degrees. Associated features affected by the event include railroad grades, trestles, inclines, cut and fill earthen structures, logging camps, donkey sets and associated equipment.

Presently, 14 grazing allotments are either wholly or partially affected by the Rim Fire. Historic records, maps and oral accounts encompassing the allotment boundaries indicate intensive livestock grazing occurred from the 1850s to the early 1920s. Some of the existing trail system is likely connected to moving livestock to summer pasturage. Associated features affected by the fire include fences, wooden troughs and collapsed wooden structures (range cabins).

Environmental Consequences

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Potential direct effects include displacement and/or obliteration of surface and subsurface deposits from mechanical site preparation methods which include: deep tilling, forest cultivation (subsoiling), mastication (shredding), harvest of non-commercial timber using a tracked feller buncher, machine piling and burning, and use of prescribed fire. Activities conducted during this project have the potential to uncover previously unknown cultural resources where deposits are largely subsurface.

Pursuant to the Rim PA (project record), all sites will be delineated with coded flagging and/or other effective marking (i.e., "flag and avoid) for protection prior to project implementation. Where opportunities are identified and approved by the Forest Archaeologist, or their designated individual, the Forest will implement Stipulation II (E)(a) of the Rim PA (project record) in order to remove smaller diameter noncommercial timber (biomass), standing dead and hazard trees from within site boundaries utilizing a variety of harvest methods including one-end suspension, a feller-buncher and rubber tired machinery. Removal of these trees will benefit the long term recovery and preservation of cultural resource sites by reducing future fuel build-up and fire weakened trees that could fall and impact already fragile resources. These alternative methods are low risk, and pose only minimal temporary impact in the form of light surface scrapes to cultural resources. In all cases Forest heritage resource specialists will be present to authorize and direct access within site boundaries. Also, sites may be avoided through project redesign.

Additionally, Alternative 1 includes extensive use of herbicides within a variety of proposed treatments (i.e. reforestation site preparation and release, noxious weed eradication, natural regeneration treatments and deer habitat enhancement) for a total of 26,585 acres treated. In all treatment areas application of herbicides will be accomplished through the use of backpack sprayers for direct localized application. In cases where noxious weeds are within cultural resource site boundaries the use of herbicides will only be allowed as long as it does not affect plant species important to California Indian Basketweavers or other Native American gatherers. In each case a Forest heritage specialist will be consulted prior to treatment within sites.

A potential indirect effect resulting from the Rim Fire and post fire recovery was the exposure of many historic and prehistoric properties to potential human vandalism and looting for financial and personal gain. During the first year after the fire, the Rim burn area was closed under Forest Order while safety issues were mitigated. This allowed vegetation across the landscape to reestablish itself and help obscure these archaeological properties which reduced access and the potential for vandalism and looting. However, site preparation and release activities for reforestation may once again temporarily expose site locations by creating the appearance of “timber/vegetation islands” indicating the location of a cultural site. The intensive post-project monitoring of sites will determine the effectiveness of treatments and lessen the potential for unanticipated effects.

Due to implementation of management requirements and monitoring, no effects to historic and prehistoric properties are anticipated under Alternative 1.

CUMULATIVE EFFECTS

All projects listed in Cumulative Effects Analysis (Appendix B) are subject to NHPA Section 106 compliance and potential effects to cultural resources would be identified at that time following stipulations in the Rim PA (project record).

Alternative 1, when combined with the past, present and reasonably foreseeable future actions and events are not expected to cumulatively lead to increased impacts to cultural resources.

Alternative 1 would continue the restoration efforts started with the Rim Recovery project. The reforestation plan would lessen the effects of future wildfire on these sites, protect fragile resources and return the ecological setting or appearance to the time of the Native American presence, thus preserving those values that would make these sites significant and allow for future studies.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

The no action alternative would present a low risk to cultural resources. Without new or increased ground-disturbing activities in the areas of known cultural resource sites, no direct effects would occur with Alternative 2.

Indirect effects to the cultural resources may occur through inaction. The existing threat of fire-weakened non-commercial and smaller diameter trees falling naturally, and potentially damaging already fragile cultural resources, would continue. The actions presented in Alternatives 1, 3, 4 and 5 would further remove dense vegetation, biomass and hazard trees preventing damage to cultural resources. The lack of action can adversely affect cultural resources through natural mortality where fire-weakened trees may uproot within archaeological sites creating increased ground disturbance and damaging already fragile resources.

CUMULATIVE EFFECTS

As stated above, Alternative 2 may have an indirect effect to cultural resources where lack of treatments within and around cultural resource sites may increase the potential for ground disturbance and damage to site features through natural processes. Other projects in the future may affect cultural resources, however no actions associated with Alternative 2 would add to these effects.

Alternative 3

DIRECT AND INDIRECT EFFECTS

The potential effects in Alternative 3 are similar to Alternative 1. Activities conducted during this project have the potential to uncover previously unknown cultural resources where deposits are largely subsurface. Unlike Alternative 1, ground disturbing activity will substantially increase due to the absence of herbicide treatments. Increased ground disturbance through deep tilling, forest cultivation and hand grubbing increases the chance to uncover previously unknown cultural resources where deposits are largely subsurface. As with any project, should heritage properties be located during implementation, activities will cease in the area and the District Archaeologist or designated individual will be notified immediately.

As this alternative does not propose the use of any herbicides for site preparation, noxious weed treatment or deer habitat enhancement, it is not anticipated to have any effects on cultural values, particularly plant species important to California Indian Basketweavers or other Native American gatherers.

Due to implementation of management requirements and monitoring, no effects to historic and prehistoric properties are anticipated under Alternative 3.

CUMULATIVE EFFECTS

Same as Alternative 1.

Alternative 4

DIRECT AND INDIRECT EFFECTS

The potential effects in Alternative 4 are similar to Alternative 1 in that treatments will include all forms of mechanical site preparation; however Alternative 4 drastically reduces the amount of site preparation to 20% of each unit for a total of 2,867 acres and dramatically increases the use of prescribed fire to 30,000 acres. Due to the increased use of fire, the potential for impacting cultural resource sites with wooden remains increases exponentially. Additional on-site monitoring during implementation and post implementation by a cultural resource specialist of the identified significant cultural resources sites will be required to ensure protection measures are effective.

Alternative 4 also includes use of herbicides within a variety of proposed treatments (i.e. reforestation site preparation and release, natural regeneration treatments and deer habitat enhancement) for a total of 2,867 acres treated. In all treatment areas application of herbicides will be accomplished through the use of backpack sprayers for direct localized application.

Due to implementation of management requirements and monitoring, no effects to historic and prehistoric properties are anticipated under Alternative 4.

CUMULATIVE EFFECTS

Same as Alternative 1.

Alternative 5

DIRECT AND INDIRECT EFFECTS

Same as Alternative 1.

CUMULATIVE EFFECTS

Same as Alternative 1.

Summary of Effects Analysis across All Alternatives

For all action alternatives, mechanical site preparation methods which include: deep tilling, forest cultivation (subsoiling), mastication (shredding), harvest of non-commercial timber using a tracked feller buncher, machine piling and burning, and use of prescribed fire would have no direct effect, minimal indirect effects and no cumulative effects to cultural resources. Cumulative effects for Alternatives 3, 4 and 5 are the same as Alternative 1. No anticipated direct effects and cumulative effects to cultural resources are expected under Alternative 2 (No Action), as no project activity would occur; however, some indirect effects are expected under Alternative 2.

3.05 Fire and Fuels

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

The Forest Plan includes goals, strategies and objectives to move towards creating a fire resilient forest where fire is an integral part of the system, not a landscape altering force (USDA 2010a, p. 5-7, 11-15). The broad scale Forest Plan goals for fire and fuels that apply to this project include:

- Provide a cost-effective fire management program to protect Forest resources, life and property from the effects of wildfire. Maintain natural and activity fuels at levels commensurate with minimizing resource losses from wildfire (p. 5).
- Treat fuels in a manner that significantly reduces wildland fire intensity and rate of spread, thereby contributing to more effective fire suppression and fewer acres burned (p. 13).
- Treat hazardous fuels in a cost-efficient manner to maximize program effectiveness (p. 13).
- Strategically place treatment areas across landscapes to interrupt potential fire spread, removing sufficient material in treatment areas to cause a fire to burn at lower intensities and slower rates of spread compared to untreated areas, and considering cost-efficiency in designing treatments to maximize the number of acres that can be treated under a limited budget (p. 14).

In October 2013, Forest Service Fire and Fuels staff from the Stanislaus and Pacific Southwest Research Station compiled a strategy for the Rim Fire area within the Rim Fire Vegetation Resiliency Plan (project record). This strategy outlined conditions along with features on the landscape that could help reduce the size and severity of future fires, and specifically addressed reforestation.

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

- The analysis area is the project area as described in Chapter 2.
- Duration of short-term effects is 20 years; duration of long-term effects is 40 years.
- The cumulative effects analysis area is the Rim Fire perimeter, including NFS lands and those under other ownership.

Assumptions Specific to Fire and Fuels

- The Rim Recovery project required units to be at 10 to 20 tons per acre post implementation.
- Vegetation condition in areas not covered under the Rim Recovery project will be similar to past fires in this area that were not salvaged or did not have fuel reduction treatments.
- Historical weather represents future conditions in these locations. This assumption is a conservative estimate of future weather conditions as climate change is predicted to increase surface air temperatures increasing the size and severity of fires in the Sierra Nevada (Miller et al. 2009; Miller and Safford 2012; Safford 2013).

Data Sources

- Vegetation Plots for Reforestation in proposed units
- Stand Profiles within the Rim Fire
- FlamMap fire behavior modeling
- FOFEM version 6.0 tree mortality modeling
- LANDFIRE Data Access Tool (2014)
- Forest GIS shapefiles displaying information within the Rim Fire

Fire and Fuels Indicators

- **Tree Mortality**: tree mortality from wildfire and prescribed fire can be measured using crown scorch volume. Crown scorch volume is determined by the percentage of crown scorched on a tree represented as a fraction of the crown. Low-intensity fires readily kill seedlings less than 12 inches in height, while larger seedlings, saplings and pole-sized trees may be damaged but not killed, especially if the burn occurred during the dormant season (Reinhardt and Ryan; 1988).
- **Flame Length**: the length of flame measured in feet. Increased flame lengths increase resistance-to-control and likelihood of torching events and crown fires.
- **Fireline Intensity**: the rate of energy or heat release per unit length of fire front.
- **Fuel Loading**: the amount of flammable material that surrounds a fire. Fuel load is measured by the amount of available fuel per unit area, usually tons per acre.

Fire and Fuels Methodology by Action

Stand profiles (a vertical cross section of a fuel bed down to mineral earth showing fuel types, size and amount) were gathered and analyzed using representative 0.02 acre plots throughout the project area. The data was used to compare current fuel loading to projected future conditions.

The dynamics between vegetation and fire and fuels are inherently linked. Fire has a profound effect on vegetation establishment and development and conversely, vegetation treatments (and the absence thereof) have a profound effect on fuels accumulations and tree mortality. The analysis considers forest vegetation, fuels and fire at the stand level.

Predicted tree mortality from fire is heavily influenced by tree species, size and height. Increased scorch heights and percentage of crown scorched correlate closely to higher tree mortality. Scorch height is influenced in part by fuel type, fuel arrangement, fuel moisture and, weather conditions.

Predicted fire effects are estimated using the predicted length of flame measured in feet and the predicted fireline intensity measured in British Thermal Units (BTU) per foot per second at the head of the fire. Increased flame lengths can increase the likelihood of torching events and crown fires. Flame length, like scorch height, is influenced in part by fuel type, fuel arrangement, fuel moisture and weather conditions. Resistance-to-control, flame length and fireline intensity influence how fast firelines can be constructed by different suppression resources, including hand crews and mechanical equipment.

Flame lengths over 4 feet, fireline intensities over 100 BTU per foot per second, or high resistance-to-control may present serious control problems. These conditions are too dangerous to be directly contained by hand crews (Schlobohm and Brain 2002; Andrews and Rothermel 1982). Flame lengths over 8 feet or fireline intensities over 500 BTU per foot per second are generally not controllable by ground-based equipment or aerial retardant and present serious control problems including torching, crowning and spotting.

Increased flame lengths increase the likelihood flame length and fireline intensity directly affecting suppression tactics. Table 3.05-1 outlines how flame lengths and fireline intensities influence fire suppression actions (Andrews et al. 2011). Predicting the potential behavior and effects of wildland fire is an essential task in fire management. Mathematical surface fire behavior and fire effects models and prediction systems are driven in part by fuelbed inputs such as load, bulk density, fuel particle size, heat content and moisture of extinction.

Table 3.05-1 Surface Fire Flame Length and Fireline Intensity Suppression Interpretations

Flame Length (feet)	**Fireline Intensity** (BTU/feet/second)	**Interpretation**
0 to 4.0	0 to 100	Fires can generally be attacked at the head or flanks by persons using hand tools. Hand line should hold the fire.
4.1 to 8.0	101 to 500	Fires are too intense for direct attack on the head by persons using hand tools. Hand line cannot be relied on to hold the fire. Equipment such as dozers, pumpers and retardant aircraft can be effective.
8.1 to 11.0	501 to 1,000	Fires may present serious control problems: torching out, crowning and spotting. Control efforts at the fire head may be ineffective.
11.1 plus	1,001 plus	Crowning, spotting and major fire runs are probable. Control efforts at head of fire are ineffective.

To facilitate use in models and systems, fuelbed inputs have been formulated into fuel models (Scott and Burgan 2005). Table 3.05-2 displays a list of fuel models that are or can be expected to be in the project area over the next 20 years.

Table 3.05-2 Fuel Models within the Rim Reforestation Project Area

Fuel Model	**Description**	**Flame Length** (feet)	**Fireline Intensity** (BTU/feet/second)
NB9	Bare Ground	0	0
GR1	Short Grass Low Load	0 to 3	45
GR2	Short Grass Moderate Load	1 to 8	300
GS2	Grass and Shrub	4 to 8	500
SH1	Low Load Shrub	0 to 1	125
SH2	Moderate Load Shrub	1 to 4	400
SH5	High Load Shrub	12 to 25	3,700
TL1	Recently Burned	0 to 1	5
TL2	Low Load Broadleaf Litter	0 to 1	7
TL4	Small Down Log	1 to 4	25
TL5	High Load Conifer Litter	1 to 4	50
TL7	Large Down Logs	1 to 4	50
TL8	Timber Litter	1 to 4	150
SB4	Blowdown with brush and small tree intermixed	12 to 25	3,000

FlamMap (Finney 2006) is designed to examine the spatial variability in fire behavior assuming that fuel moisture, wind speed and wind direction are held constant in time, thereby allowing for more direct comparison of fuel treatment effects. FlamMap allows the user to easily characterize fuel hazard and potential fire behavior, as well as analyze fire movement and fuel treatment interactions. The fuel models used in this analysis are based on publication GTR-153 (USDA 2005). Fuel models used are estimates of what the fuel loading and fire behavior are currently and what is predicted in the future. The results of the calculations and estimates are intended to show trends and potential effects and are not statistically accurate. The FlamMap modeling system was used to estimate average fire behavior for each alternative. Flame length and fireline intensities were used to measure the effects of all alternatives.

Table 3.05-3 displays the 90th percentile values taken from the Fire Family Plus (Main et al. 1990) program using the Mount Elizabeth Remote Automated Weather Station during the period of April 1, 1970 to October 31, 2013. For modeling purposes the fire weather adjective defined as High (90th percentile weather) was used to predict fire behavior in the analysis area.

Table 3.05-3 Weather Parameters for High Conditions (90th Percentile Weather)

Parameter	Value
1-hour fuel moisture (0 to 0.25 inch diameter)	4%
10-hour fuel moisture (0.25 to 1 inch diameter)	5%
100-hour fuel moisture (1 to 3 inch diameter)	7%
1000-hour fuel moisture (3 inch plus diameter, CWD)	9%
Herbaceous fuel moisture	30%
Woody fuel moisture	70%
20-foot wind speed (mph)	10

CWD=Coarse Woody Debris; mph=miles per hour

Affected Environment

Plant communities within the project boundaries included Westside Ponderosa Pine Forest, Sierran Mixed Conifer Forest, several different chaparral communities such as Montane Manzanita Chaparral and Northern Mixed Chaparral, Montane Meadow, White Alder Riparian Forest, Aspen Riparian Forest, Blue Oak Woodland and other oak woodland communities (Holland 1986). Many of them burned with a moderate to high intensity in the Rim Fire where the conifer overstory was completely killed.

In addition, past wildfires (prior to the Rim Fire) and the subsequent salvage logging and reforestation activities created over 20,000 acres of young plantations. Many plantations were in various phases of growth and had been thinned in the past 15 years. Due to their mostly early seral nature, the plantation understories had low native plant diversity and were primarily composed of disturbance followers such as non-native annual grasses and native shrubs like deerbrush (*Ceanothus integerrimus*), manzanita (*Arctostaphylos* sp.), bearclover (*Chamaebatia foliolosa*) and Sierra gooseberry (*Ribes roezlii*).

Existing Conditions

Existing conditions include past projects (salvage logging, fuels reduction, wildfires and other activities) and present and future projects as listed in Appendix B. This timeframe allows the comparison of alternatives during the time when fuel profiles change significantly after a wildfire and during reforestation and is representative of the fire return interval for the project area.

The 2013 Rim Fire and the salvage and fuel treatments that occurred post fire created low fuel loadings (10 to 20 tons per acre depending on landscape location) within the majority of the reforestation and natural regeneration units, over 20,000 acres. Those units outside of these areas have standing dead small trees and sprouting brush remaining on site and are proposed for initial site preparation (fuels reduction) treatments to remove those fuels Snags and large logs are present in the units to meet resource needs and Forest Plan direction. Duff and litter layers are currently not present at a level that would affect fire behavior. Sprouting vegetation including oaks, bearclover, manzanita and deerbrush are abundant throughout the burned area two years post-fire. Out-year fire effects are expected to be dominated by young shrubs, small trees and hardwoods reoccupying the site.

Although burned in the Rim Fire, few of the deer habitat enhancement units were salvage logged post Rim Fire. These areas are on and adjacent to an open lava cap with oak/grasslands, existing plantations and brush fields.

Within the existing plantations, trees range in size from 2 to 16 inches dbh and up to 30 feet tall. The understory vegetation is low, but many plantations are over stocked and have overlapping crowns. Duff layers exist, but are shallow, primarily developing from needle cast and dead woody brush.

Noxious weeds are abundant throughout the project area, some of which create a more flashy fuel situation. As the weeds spread and increase in volume, an increase in ladder fuels occurs. Weeds such as Scotch broom, Medusahead, barbed goatgrass, yellow star-thistle and others, change the arrangement of vegetation, the amount of soil moisture at specific times of the year, the amount of fuel available to burn and how fire behaves (Keeley et al. 2011).

Environmental Consequences

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

In Alternative 1, planted conifers would have a better chance of surviving future wildfires due to anticipated surface fuel load reductions through herbicide and other site preparation and release treatments and the incorporated fuelbreaks.

The FOFEM 6 modeling program was used to determine tree mortality within young plantations (approximately 10 years old) from prescribed or natural fire. The data shows that within young plantations where trees are less than 4.5 feet tall, short flame lengths (2 feet) would cause the same mortality (80 to 100% depending on species) as the higher flame lengths (10 feet). As trees grow, the effects of two foot flame lengths lessen quickly and by age 20 most species see less than 10% mortality, but have the same range of mortality (80 to 100%) for 10 foot flame lengths. Ponderosa pine has the lowest mortality as trees grow through time and even by age 10 are seeing this drop in the shorter flame lengths. This species also grows the fastest within young plantations allowing it to reach these larger diameters and heights sooner.

Using empirical data for northern California forests, Weatherspoon and Skinner (1995) found that when wildfire in natural stands spreads to an adjacent plantation, fire intensity and damage to the overstory are much lower in plantations where slash has been removed following logging (Peterson et al. 2009). Until tree age and canopy base heights increase, younger conifer and hardwood stands would be susceptible to increased mortality. Younger trees have thinner bark and low canopy base heights allowing for easier transition to crown fire, even with predicted flame lengths at less than four feet over the majority of the proposed units. Maintaining lower surface fuel levels through follow-up herbicide release treatments on competing vegetation would help reduce tree mortality.

Proposed treatments would alter the spread and effect of fire in the project area. Units were strategically placed to affect fire movement on the landscape and provide advantageous areas for fire suppression actions. As managers continue to move the forest toward the desired condition, fire would be able to resume its natural role in developing and sustaining these ecosystems. Continued management practices can and will alter the effects of wildland fire (Agee and Skinner 2005).

As the vegetation matures, fuel loadings would increase. Continued maintenance through prescribed fire is designed to achieve the desired condition that would maintain fuel profiles allowing fire to resume its ecological role and meet Forest Plan Direction.

Suppression actions would not be restricted by fire behavior; thus direct suppression actions would be possible within the young plantations (Fites et al. 2010).

The effect on fire suppression forces beyond year 20 would depend on the continued maintenance of the plantations. Proposed site preparation and release treatments followed by the reintroduction of fire into these young stands would help maintain the desired condition and not adversely impact future suppression. FlamMap 5.0 modeling program was used to project fire effects and production rates for Alternative 1. Predicted flame lengths would be less than or equal to four feet for the first 20 years post implementation. Fireline intensity (the rate of energy or heat release per unit length of fire front) would be less than 100 feet over the next 20 years. This means fires can generally be attacked at the head or flanks by persons using hand tools and hand line should hold the fire.

Alternative 1 utilizes a variety of planting patterns including low density and widely spaced patterns on fuelbreaks and adjacent to emergency travel routes and fewer trees per acre in clumpy patterns in the majority of the landscape where Open Forest Mosaic is the desired future condition. Short-term, within the first 20 years, these different spatial patterns do not lessen tree mortality because of seedling size and the amount of brush present post-reforestation treatments. These patterns also have no effect on flame length, fireline intensity or fuel loading because at this stage of development either small trees or brush will occupy the site and both have similar flammability and burn patterns.

Maintaining fuelbreaks over time would potentially reduce fire size, increase tree survivability and create potential anchor points and contingency lines for suppression resources. Emergency travel routes would create safe ingress/egress routes during wildfire events.

Long-term, the proposed units would create a fire resilient forest with a more historic heterogeneous structure where fire is an integral part of the system in the project area. Unit prescriptions and Strategic Fire Management Areas would affect fire movement on the landscape and provide advantageous areas for fire suppression actions. Commercial thinning could be used to maintain the desired stand structures and shaded fuelbreaks as well as fuel treatments within the SFMAs, fuelbreaks and emergency travel routes.

Deer habitat enhancement units would have similar effects as the reforestation units discussed above because they would have similar treatments. In addition, this area calls for more prescribed fire to be utilized for brush reduction and within plantations to maintain smaller pockets of conifers for habitat needs. More frequent prescribed fire would keep the fuel loadings at a lower level.

Within existing plantations, thinning of densely planted stands into an ICO structure would increase survivability by reducing the continuity of fuels and the likelihood of crown fire. In addition, thinning these stands would encourage faster tree growth of the remaining trees, allowing them to become more resilient to future low intensity fires.

Invasive species alter the natural vegetative pattern, often providing more flammable fuels into the system. Eradication of the noxious weeds and their flashy fuel conditions would allow native vegetation to return to these landscapes beneficially affecting fire behavior.

Alternative 1 proposes treatments that would improve and maintain lower fuel levels within newly establishing forests which would not only promote the recovery of this landscape, but allow fire to be an integral part of it. It attempts to ensure long-term tree survival as well as protecting fire fighters and property.

CUMULATIVE EFFECTS

Previously implemented and foreseeable fire salvage, thinning and fuels treatments on both private and NFS lands, in conjunction with Alternative 1, would enable effective fire suppression action to be conducted. Incorporating fuelbreaks and emergency travel routes into the initial planting design under this alternative would provide connectivity of these features within previously implemented projects. Coordinated fire suppression tactics would be easier to implement across all ownerships. With these conditions, future fires would burn as surface fires with low flame lengths and fireline intensities. These lower-intensity fires could be suppressed using direct attack with hand tools.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

In Alternative 2 no planting or associated site preparation and release treatments, which would maintain fuels at a relatively low density, would take place. Existing plantations would remain overstocked with dense contiguous canopies and ladder fuels. In addition, none of the noxious weed eradication or deer habitat enhancement would occur leaving less desirable non-native fuel types throughout the area.

Existing conditions would persist and develop unaltered by active management. It is a reasonable expectation that areas within the Rim Fire would develop in a similar manner as those non-planted areas in other recent local fires. Examples of such fires include the Big Meadow Fire (2009), North Mountain Fire (2008), Early Fire (2004), the Ackerson Fire (1996) and Larson Fire (1987). In those areas, grasses such as cheat grass (*Bromus tectorum*) and various shrubs including ceanothus (*C. cordulatus, C. velutinus*) and manzanita (*Arctostaphylos patula*) now fully occupy the site and limited amounts of conifers have returned. Post-fire vegetation plots taken in proposed reforestation and natural regeneration units within high burn severity areas show that an average of more than 70% vegetative cover has returned to these areas and less than 40% (including the proposed natural regeneration units) have any natural regeneration.

Figure 3.05-1 shows shrub regeneration two years after the Rim Fire. Very few live trees per acre characterize the forest structure following a high-intensity fire, resulting in limited natural conifer regeneration. Over time, ladder and crown fuels would develop where natural regeneration established.

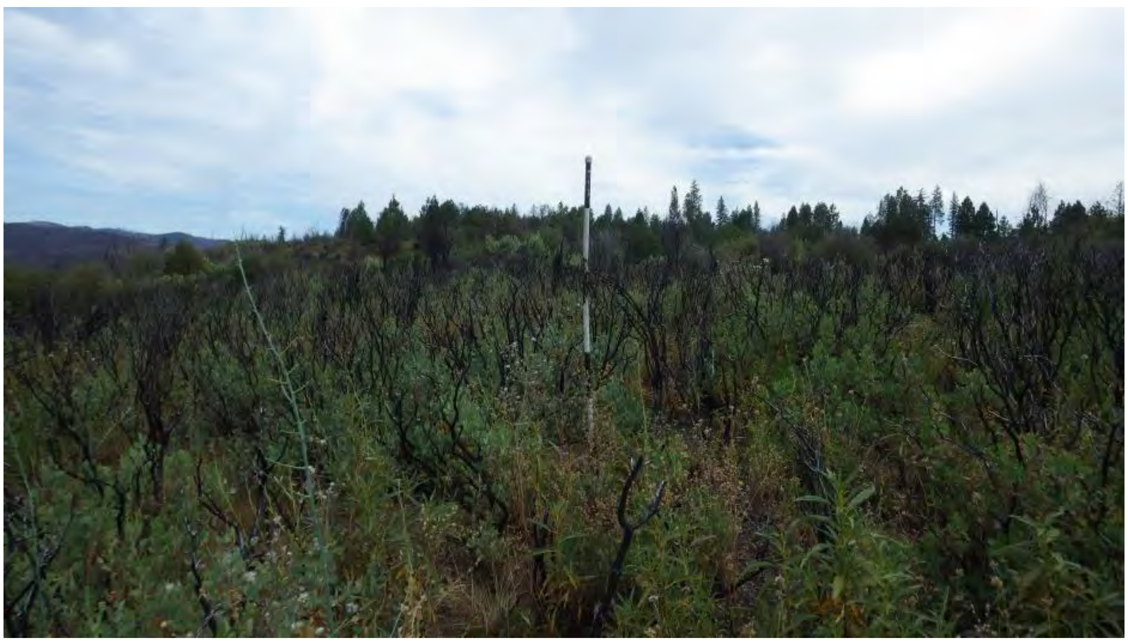

Figure 3.05-1 Shrub Regeneration Two Years after the 2013 Rim Fire

Not implementing treatments would result in increased surface fuels and increased crown scorch volume resulting in higher tree mortality on the natural regeneration that does return. Overall, Alternative 2 would not reduce future surface fuels or predicted fire effects in both the reforestation and deer habitat enhancement areas.

None of the proposed fuelbreaks, emergency travel routes, or SFMAs would be maintained over time creating less safe ingress/egress routes for fire firefighters during wildfire events and fewer anchor points for suppression.

Existing over-stocked plantations would remain vulnerable to wildfire since they would not be thinned to the desired ICO structure. Tree mortality would be far higher in these stands where contiguous interlocking crowns would carry wildfire. These unthinned stands would also have higher flame lengths, higher fireline intensity and much higher fuel loading than those thinned in the action alternatives where the ICO structure would create openings and heterogeneity in the fuels across these units.

Eradication of noxious weeds and their flashy fuel conditions would not occur. Invasive species would continue to provide more flammable fuels in these areas negatively affecting fire behavior.

CUMULATIVE EFFECTS

Under Alternative 2, the salvage and fuels reduction treatments that occurred under the Rim HT and Rim Recovery projects would still remove hazard trees along Forest Service roads and accomplish the initial reduction of fuels to 10 to 20 tons per acre. Without the maintenance of these fuel levels and the reduction of brush from the action alternatives, much of the gain in the effects to fire behavior would be lost within a few years. When the effects of Alternative 2 are combined with the effects of implementing the foreseeable activities (Appendix B), this alternative would not maintain the SFMAs. Neither would it aid in future fuels management, suppression, or beneficial fire planning objectives. The cumulative effects of No Action would be an increase in fire behavior over time and negative fire effects on the landscape.

Alternative 3

DIRECT AND INDIRECT EFFECTS

Alternative 3 differs from Alternative 1 in the number of acres that would have site preparation and the methods of treatment. No herbicides would be used under this alternative which reduces the site preparation acres by 12,407 and the noxious weed treatments by 2,565 acres, but would treat the same number of deer habitat enhancement acres. In addition, the release treatments are limited to grubbing vegetation in five foot radius circles around each seedling which means less than half of the area would have vegetation removed during each release treatment (e.g. a unit with 250 seedlings per acre would only grub 45% of the area). Depending on the competing species, this would require more than one grub per year and several consecutive years of treatment to meet desired tree survival levels. Although many of the effects would be similar to Alternative 1, these differences in the amount and size of vegetation on site would likely negatively affect tree mortality, flame length, fireline intensity and fuel loading. Over time higher planted tree mortality is expected than Alternative 1 (3.13 Vegetation), reducing the need for 5 foot radius hand grubbing and incrementally increasing fuel connectivity. The five foot radius circles should break up fuel continuity enough to make these affects minor within the first 10 years of plantation development.

This alternative proposes to establish fuelbreaks and SFMAs throughout the landscape similar to Alternative 1; the difference is in the fuelbreak design. It proposes increasing the amount of non-planted area within the fuelbreak for ease of maintenance and fire fighter safety during wildfires.

CUMULATIVE EFFECTS

Same as Alternative 1.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Alternative 4 serves to enhance the opportunity to achieve the overall goal in the Forest Plan to reintroduce fire by proposing prescribed burning on more than 19,000 additional acres within the project area. As managers continue to move the forest toward the desired future condition, fire would be able to resume its natural role in developing and sustaining these ecosystems. Alternative 4 proposes only planting 20% of the area in 2 to 10 acre blocks, but burning the adjacent areas (almost 32,000 acres) every 20 years. It does not propose re-introducing fire into the young plantations at year 10 or creating SFMA areas or features. However, utilizing prescribed fire outside of the reforestation areas to maintain low fuel levels would result in desirable fuel conditions across this landscape and likely prevent damage to young plantation during wildfires. Within the founder stands, none to limited tree mortality would be expected because these areas are being treated with herbicide to maintain a low brush component and provide a treated buffer enabling fire crews to protect them during implementation. However, the founder stand concept of natural regeneration occurring adjacent to these areas as planted trees mature and seed spreads would have high seedling mortality during prescribed fire operations. Burning in a mosaic pattern across the landscape would enable some trees to survive to maturity over time, but most would be lost during implementation.

CUMULATIVE EFFECTS

Even though no fuelbreaks or emergency travel routes are proposed in this alternative the amount of prescribed burning throughout the area would provide connectivity of these features within previously implemented and future projects. Coordinated fire suppression tactics would be easier to implement across all ownerships, similar to Alternative 1.

Alternative 5

DIRECT AND INDIRECT EFFECTS

Similar to Alternative 1. Although the initial planting design does not propose Strategic Fire Management Areas or Features, the pre-commercial thinning at age 7 would create these desired structures. Not re-introducing fire into the plantations would lower the tree mortality in these stands in the short-term, but in the long-term increase the flame length, fireline intensity and fuel loading.

CUMULATIVE EFFECTS

Same as Alternative 1.

Summary of Effects Analysis across All Alternatives

In the short-term (20 years) the difference in tree characteristics effecting fire related mortality between alternatives is negligible. However, the action alternatives are designed to help protect forest stands through the incorporation of fuelbreaks and travel routes or vegetation control that would aid in fire suppression effectiveness and increase the likelihood of tree survival.

All action alternatives would have the same flame length over first 20 years post planting. Alternative 2 is projected to have double the flame length over the first 5 years and over three times the flame length by year 20 (13 feet compared to only 4 feet). Fireline intensity inside treated units would be the same for all action alternatives, but Alternative 2 would be far higher after just five years (100 versus 500) and by age 20 it is projected to be 10 times the rate present in the treated units.

3.06 Invasive Species

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

The following direction guides management of invasive plants on NFS lands:

- Executive Order 13112 Invasive Species 64 FR 6183 (Clinton 1999)
- FSM 2900 (USDA 2011)
- Pacific Southwest Region Noxious Weed Management Strategy (USDA 2000)
- Noxious Weed Management Standards and Guidelines (USDA 2010a, p.52)

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

Assumptions Specific to Invasive Species

- Existing plant survey data covers approximately 98% of the total project area.
- New and expanding infestations will result from habitat alterations caused by the fire (e.g. decreased canopy cover, increased nitrogen and water availability) and fire suppression activities.
- The risk of creating new or expanding invasive populations throughout the project area depends on a variety of factors (these factors are listed in the Summary of Effects Analysis across All Alternatives section).
- Without specific prevention and control measures, invasive non-native plants (noxious weeds) will continue to spread along and within project areas and into adjacent areas.
- Weeds are likely to persist long term once they are established in meadows.

Data Sources

- GIS layers of invasive plant infestations and units based on GIS shapefiles provided by the Mi-Wok and Groveland District botanists with data collected from 2006 to 2015.
- Information on species status, distribution, and ecology was derived from general literature reviews, Forest Service documents, the Forest Service Fire Effects Information System, California Department of Fish and Wildlife, various field books, floras, and personal communications. Site surveys, in conjunction with literature and input from the District botanists were used to determine the potential occurrence of each species, its habitat and its priority for eradication and control.

Invasive Species Indicators

- Acres within ground-disturbing project locations containing infestations of invasive plant species.
- Acres planned for eradication treatments or reforestation (site preparation and release) treatments.

Invasive Species Methodology by Action

This analysis evaluates the factors influencing invasive plant introduction and spread by considering the risks of, and vulnerability to, invasive plant establishment.

Affected Environment

Existing Conditions

Thirty species of non-native and invasive plants are present or adjacent to (within 5 miles) the project area (Table 3.06-1). Table 3.06-1 does not list Bachelor button, cheat grass, scotch broom, and Spanish broom which are known within the Rim Fire but not proposed for treatment. Table 3.06-1 also shows the non-native invasive species (NNIS) known treatment population acres for each alternative (this includes an additional 20% over the mapped acreage for medusahead grass and tocalote and an additional 10% for all other species to account for population spread prior to treatment).

Table 3.06-1 Invasive Species within Rim Fire and Known Populations Proposed for Treatment

Name	In Rim Fire (acres)[1]	Alternative 1	Alternative 3	Alternative 4	Alternative 5	Project Priority[2]
Barbed goatgrass	4.70	3.71	3.71	3.71	3.71	High
Blackberry, cut-leaf	0.11	0.07	0.07	0.07	0.07	Low
Blackberry, Himalayan	24.56	27.02	5.50	5.50	27.02	Low
Black mustard	1.33	1.44	1.44	1.44	1.44	Moderate
Bull thistle	327.73	360.50	56.99	56.99	360.50	High (DI); Low (SP)
Canada thistle	0.29	0.04	0.04	0.04	0.04	High
Dyers woad	0.74	0.81	0.81	0.81	0.81	High
Field bindweed	0.73	<0.01	<0.01	<0.01	<0.01	Moderate
French broom	0.40	0.44	0.44	0.44	0.44	Moderate
Italian thistle	30.41	28.16	15.65	15.65	28.16	High
Johnsongrass[3]	4,297.94	42.97	<0.01	<0.01	42.97	Moderate
Klamathweed	2.20	1.34	1.29	1.29	1.34	Low
Medusahead grass	3,486.23	3,767.20	2,967.26	2,967.26	3,767.20	High
Milk thistle	0.35	0.13	0.13	0.13	0.13	Moderate
Oxeye Daisy	0.04	0.04	0.04	0.04	0.04	High
Perennial sweetpea	2.40	2.64	2.64	2.64	2.64	Moderate
Puncturevine	0.10	<0.01	<0.01	<0.01	<0.01	High
Shortpod mustard	0.04	0.04	0.04	0.04	0.04	Moderate
Spotted knapweed	1.23	0.96	0.80	0.80	0.96	High
Sulphur cinquefoil	0.07	0.08	0.08	0.08	0.08	High
Tall Sock destroyer	0.02	0.02	0.02	0.02	0.02	Low
Tocalote	1,045.80	493.03	0.47	0.47	493.03	High
Tree of Heaven	<0.01	<0.01	<0.01	<0.01	<0.01	Moderate
Tumble mustard	107.08	112.90	112.70	112.70	112.90	Moderate
Woolly mullein	196.23	215.85	15.97	15.97	215.85	Moderate (DI); Low (SP)
Yellow star-thistle	2,461.57	776.74	196.97	196.97	776.74	High
Totals[4]	**11,992.39**	**5,836.15**	**3,383.07**	**3,383.07**	**5,836.15**	

DI=Dense Infestations; SP=Scattered Plants

1 <0.01 indicates population size is less than one hundredth (0.01) of an acre.

2 Project priority determined by invasive characteristics, habitat degradation potential, state rating, prevalence across the fire area, and control factors of the plant. In addition, the risk of potential seed and reproductive part spread from project activities was considered.

3 Johnsongrass acres are mapped to heli-mulch units with actual treatment acres assumed to be one tenth of the acreage.

4 Totals shown here are greater than the noxious weed treatment acres shown for each alternative in Chapter 2 due to overlapping populations of different species.

Ten species are considered a moderate risk, including: barbed goatgrass (*Aegilops triuncialis*), Italian thistle (*Carduus pycnocephalus*), tocalote (*Centaurea melitensis*), yellow star-thistle (*Centaurea solstitialis*), spotted knapweed (*Centaurea stoebe ssp. micranthos*), Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), dyer's woad (*Isatis tinctoria*), medusahead grass (*Taeniatherum caput-medusae*) and puncturevine (*Tribulus terrestris*) are considered high risk species from project activities. Eleven other species, including, bachelor buttons (*Centaurea cyanus*), field bindweed (*Convolvulous arvensis*), Scotch broom (*Cytisus scoparius*), French broom (*Genista monospessulana*), shortpod mustard (*Hirschfeldia incana*), perennial sweatpea (*Lathyrus latifolius*), milkthistle (*Silybum marianum*), tumblemustard (*Sisymbrium altissimum*), johnsongrass (*Sorghum halepense*), Spanish broom (*Spartium junceum*) and wooly mullein (*Verbascum thapsus*). The remaining five species are considered low risk. The Noxious Weed Risk Assessment includes a complete discussion of characteristics specific to each species, habitat impacts and recommended management tools.

Past actions involving ground disturbing activities such as timber removal, fuel reduction, road and trail creation or maintenance, grazing, unauthorized motorized use and other dispersed recreation impacted invasive plant infestations across the project area. The invasive species known to occur within the project area before the Rim Fire were introduced and spread primarily through transport on vehicles, in straw and hay, on earthmoving, mowing or weed-eating equipment, and on animals and in their manure associated with these activities. Weed seeds also spread quickly down streams and upwind along lakes and reservoirs. Livestock grazing also contributed to weed spread, due to transportation on their fur, decreased native grass and forb cover from preferential grazing (avoiding the less palatable invasive species), trampling, and other soil disturbances (Olson 1999).

Given the current data (Table 3.06-1), Medusahead grass, tocalote, yellow star-thistle, bull thistle and johnsongrass are by far the most common species within the project area. Johnsongrass acreages are mapped to heli-mulch units, and actual treatment acres are assumed to be one tenth of the acreage shown in mapping. To a lesser extent, several other invasive weed species occur, primarily along roads. It should be noted however, that it is highly likely that many of the lower priority invasives (such as cheatgrass) are mapped at a fraction of their actual occurrence acreage given their commonality. All proposed treatment areas will be surveyed prior to implementation as per management requirements.

The risk of creating new or expanding populations depends on a variety of factors:

- **Species-specific dispersal traits of weeds**. Weed species with seeds dispersed by wind (Italian thistle), by tumbleweed (shortpod mustard), water (tamarisk), or animals (Medusahead grass) can potentially spread weed propagules miles from their original sources. Most seeds are not moved far from the parent plant, but a small proportion of seeds can be found large distances away. Even propagules with low innate dispersal abilities, such as stem fragments of giant reed or castor bean seeds which fall close to the plant, can be carried a great distance after initial dispersal by streams or surface runoff. However, species without wind, water, or animal-mediated dispersal are less likely to disperse propagules far from the original source.
- **Habitat disturbed**. While many weed species are generalists that can potentially colonize a fairly wide range of habitat types, those with ample nutrients and soil moisture or those that have been recently disturbed, are more susceptible to invasion. Additionally, the suite of weed species one would expect to colonize a site is dependent to some degree on the habitat where the disturbance occurred.
- **Regional patterns in weed occurrence and propagule pressure**. The project occurs across a transitional area with regards to microclimate, elevation, and vegetation communities. The most commonly observed weeds differed within these areas, possibly due to species-specific habitat preferences.
- **Type of ground disturbance**. The type of disturbance creates conditions favoring release and establishment of different weed species. For example, tree removal is expected to favor the establishment of weed species that do best in full sun, such as yellow star-thistle; burning is expected to favor the establishment of fire-adapted weed species such as French broom; and soil disturbance is expected to favor the establishment of early-colonizing weed species, such as mustards or tocalote, that respond favorably to disturbed, denuded soils.
- **Planned treatment of known infestations and use of standard management requirements**. Treatment of NNIS occurrences are planned in all of the action alternatives. Additional treatment of NNIS would occur through site preparation and release activities by herbicide in Alternatives 1, 4 and 5. All action alternatives propose treatment of NNIS, but prescribe different techniques

and differing amounts of treatment. Standard management requirements would reduce the risk of spread within the project area and are prescribed for all action alternatives.

These factors were used to consider the risks associated with the establishment of new weed infestations due to project activities. In addition to these 5 factors, the results of the Noxious Weed Risk Assessment focused on risks associated with the 1) release of pre-existing but currently dormant weed seed banks at disturbed sites; 2) rapid build-up of transient weed seed banks at disturbed sites; and/or 3) creation of conditions favoring weed establishment at disturbed sites.

Environmental Consequences

Project-related activities under all action alternatives, could contribute to an increase in invasive plants in three major ways: 1) the creation of conditions that favor establishment of invasive plant (weed) species, such as soil disturbance, removal of native vegetation, or the breakup of cryptogamic crusts[6], 2) spread of new and pre-existing weed infestations into newly disturbed areas via project tools, equipment, and personnel; and 3) the subsequent release of pre-existing weed seedbanks from dormancy or the quick build-up of new weed seedbanks on disturbed soils.

Table 3.06-2 displays acreages for ground disturbing treatments in each alternative. The acreages listed are cumulative, and no attempt is made to remove overlapping areas of treatment. Treatments leading to soil disturbance and canopy reduction are likely to facilitate the spread of NNIS. Alternative 3 is the highest in cumulative acres of ground disturbing activities because of hand grubbing which would expose thousands of acres of bare soil (scattered in small patches across each unit) for up to five years. The other action alternatives have similar acres of disturbance, but the type of disturbance varies. Alternatives 1 and 4 would create more bare ground following prescribed burning activities as opposed to Alternative 5 which would hand thin young trees at age 7 and create small piles of slash for burning. These burned areas would create fertile habitat for invasive species, but be far more isolated and dispersed than the broadcast burns proposed in Alternatives 1 and 4.

Table 3.06-2 Ground Disturbing Activities by Alternative

Treatments	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanized equipment	5,895	0	5,895	248	6,194
Deep till and forest cultivate	5,085	0	8,893	0	5,085
Release with grubbing[2]	0	0	14,415	0	0
Prescribed fire	21,300	0	21,300	32,112	0
Thin new plantations	0	0	0	0	25,331[1]
Totals[3] (acres)	**32,280**	**0**	**50,503**	**32,360**	**36,610**

[1] Treatment would only be done where needed to create desired ICO structure and to meet fire and fuels structure goals.
[2] Assumes 40% of the total acres will be disturbed through hand grubbing.
[3] Cumulative total acres of ground disturbing activities leading to soil disturbance and facilitating weed spread.

The results of the Noxious Weed Risk Assessment focused on risks associated with three avenues for weed proliferation: 1) the release of pre-existing, but currently dormant, weed seed banks at disturbed sites; 2) the rapid build-up of transient weed seed banks at disturbed sites; and 3) the creation of conditions favoring weed establishment at disturbed sites. The risks are labeled “high, moderate and low,” and are defined as follows:

- High: Chances of weed species infesting new areas range between 76 to 100%.
- Moderate: Chances of weed species infesting new areas range between 31 to 75%.
- Low: Chances of weed species infesting new areas range between 1 to 30%.

[6] Cryptogamic crusts are biological soil crust composed of living cyanobacteria, green algae, brown algae, fungi, lichens, and/or mosses.

Each action alternative is expected in general to be high risk (a 76 to 100% chance) for the potential to establish new populations of invasive species, specifically those listed as high and moderate priority in Table 3.06-1. This high risk ranking was chosen after careful consideration of the first four factors listed in the Affected Environment section (e.g. weed species dispersal traits, habitat disturbed, regional patterns in weed occurrence and types of disturbance), and the three avenues for weed proliferation stated previously. For each of the action alternatives, the ranking was determined to be in the high category. Those areas that are outside of the historic fire burn return interval (i.e., burning more or less frequently) are expected to have an even higher risk (yet still within the high risk category) of experiencing vegetation type conversion in the project area.

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Disturbance by heavy equipment can have long-term effects to soils and favor weed establishment if unmitigated. Heavy equipment can compact soils, reducing water infiltration and accelerating erosion. It can also displace soils and sheer off vegetative roots. If these effects are severe, a loss of soil productivity may occur. Numerous passes by equipment over vegetation often causes plant mortality or severe injury, exposing the soil organic layer and making it more susceptible to erosion. Loss of vegetative cover and the soil organic layer reduces the ability of the soil to hold moisture. Many weed species are more capable of utilizing less productive soils with less soil moisture. In addition, some weeds produce secondary chemical compounds that inhibit native plant germination and growth. These compounds also affect nutrient cycling rates by inhibiting soil microbial fauna activity (Sheley et al. 1999).

Even those project sites in remote areas may be expected to contain an existing weed seedbank. Seedbanks are known to regularly contain a different suite of species than is represented by the standing vegetation due to succession, low reproduction rates of some perennials (by seed), and other factors (Thompson 2000). In most cases it is rare to find species in the seedbank that are not represented to any degree in the above-ground vegetation; the exception being seeds from invasive, aggressive, disturbance-adapted, and early colonizing weeds (Thompson 2000). For example, large cheatgrass seedbanks are commonly found throughout western North America, often regardless of such factors as remoteness of the site, grazing, or fire history. Within intact native communities these seeds are typically held in the above-ground vegetation or in crevices on cryptogamic crusts. Germination is therefore prevented until disturbance allows the cheatgrass seeds to come into contact with broken soil surfaces (Boudell et al. 2002).

Following establishment, new populations of weeds are often extremely difficult to eliminate, and even if controlled or eradicated, it may take several years or decades to re-establish native soil structure and biota. If allowed to expand, dense infestations can occur that not only displace native plants and animals, but also threaten natural ecosystems by fragmenting sensitive plant and animal habitat (Scott and Pratini 1995). For example, when equipment disturbance activities introduce or release weeds, the vegetative pattern is changed, often providing more flammable fuels into the system. As the weeds spread and increase in volume, an increase in ladder fuels occurs. Weeds such as Scotch broom, Medusahead, barbed goatgrass, yellow star-thistle and others, change the arrangement of vegetation, the amount of soil moisture at specific times of the year, the amount of fuel available to burn, and how fire behaves (Keeley et al. 2011). These changes in fire behavior often mean that areas that would not ordinarily burn frequently or at high intensity are now doing so (DiTomaso and Healy 2007). This is especially a concern in dry lava cap areas where weed species compete with sensitive plants.

Deep tilling under Alternative 1 would expose soil to colonization by weed species, but the associated planting could reduce this effect in the long term by establishing a canopy to discourage the continued occupation of the site by sun-loving weed species. Follow-up herbicide treatments would also greatly reduce the likelihood of weeds spreading in deep-tilling units. Prescribed burning would have mixed effects depending on the species response to fire, but in general clears the understory and provides areas for weeds to spread into.

Alternatives 1 and 5 have the highest number of weed treatment acres prescribed, 5,714 acres. Most of those acres (over 95%) would also be indirectly treated with herbicide during site preparation and release activities. These treatments and the implementation of standard management requirements reduce the risk of further weed spread from Alternative 1 from high to moderate.

CUMULATIVE EFFECTS

Factors which are not planned and are difficult to control (e.g., wildfire, dispersed recreation use, grazing, climate change) will likely have the greatest cumulative impact to native plant communities from the expansion of invasive plants for the action alternatives. Fully implementing any of these alternatives would add to this cumulative effect. For the purpose of this analysis, cumulative effects of past activities or natural events are represented within the existing conditions.

All of the activities listed in Appendix B, which spatially and temporally intersect with the project area, will contribute to effects on invasive plant proliferation. Within the project area, the Rim HT and the Rim Recovery projects are the two largest sources of ground disturbance for noxious weeds. These projects have the primary activities that will alter forest vegetation and impact invasive plants; most of the weed risk assessments for these projects show the risk to be moderate when management requirements are followed. Recreation management, road and trail work and decommissioning of unauthorized routes are additional ground disturbing activities anticipated to occur in the foreseeable future. Livestock grazing within the project area (13 allotments) may also proliferate weeds. All of these activities, in addition to other recreation activities such as dispersed camping, were ranked as low to moderate risk.

These present and future projects are cumulative in nature in that some of them overlap spatially with the project areas, but all of them impact the ability of the Forest Service to feasibly and adequately manage invasive plant proliferation. With all the different projects occurring across the forest (hazard tree removal, fuel treatments, etc.), several of which are thousands of acres in size in addition to the large size of the Rim Fire itself, it becomes very difficult to physically visit all the affected areas, let alone perform time consuming hand removal of invasives in an adequate manner. Because of overlapping implementation timeframes of this project and above mentioned projects, it is also difficult to acquire the trained personnel necessary for mitigating project impacts.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

Under Alternative 2, areas which currently have invasive plants would continue to support these species, providing seed sources for dispersal into adjacent areas. However, this alternative would eliminate the high risk of directly and indirectly spreading weeds from ground disturbing activities (all part of Alternatives 1, 3, 4 and 5). The reduction in invasive plant spread would equate to lower risk for vegetation type conversion to non-natives and better habitat and hydrologic function throughout the project area.

The risk of noxious weed spread is the highest under Alternative 2. Known noxious weeds would not be actively managed under this alternative. Additionally, much of the project would remain in a disturbed state and canopy levels would not be re-established. The majority of the known noxious weeds in the project area are sun loving and are prone to being shaded out under heavy canopies. The most important factors for reducing the risk of weed spread in the project area are reforestation treatments which re-establish resiliency to noxious weed invasion in conjunction with treatment of known noxious weeds.

Cumulative Effects

All of the activities listed in Appendix B, which spatially and temporally intersect with the project area, will contribute to effects on invasive plant proliferation. Since no weed eradication would occur under Alternative 2, existing populations would also continue to spread throughout this area and adjacent activities would contribute to this spread. Factors that are not planned and difficult to control (e.g., wildfire, dispersed recreation use, grazing, and climate change) will likely pose the greatest risk of proliferating invasive plants.

Alternative 3

Direct and Indirect Effects

Alternative 3 has a higher risk to spread weeds in the project area compared to Alternative 1. This alternative proposes 21,300 acres of hand grubbing that would expose thousands of acres of bare mineral soil for 5 years. Additionally this would preclude the indirect treatment of weeds through herbicide release. Alternative 3 only allows for hand and non-herbicide treatments of known infestations within the project area on 3,131 acres of weeds (2,583 fewer acres than Alternative 1). Non-herbicide treatments would likely result in less effective control of some species and require more treatments to ensure full eradication of those populations that can be eliminated. In summary, because Alternative 3 has the highest amount of ground disturbance and less effective noxious weed treatments the risk of noxious weed spread is high.

Cumulative Effects

Same as Alternative 1.

Alternative 4

Direct and Indirect Effects

Alternative 4 has a larger footprint than Alternatives 1 and 5 and relies heavily on natural regeneration and prescribed fire to meet project objectives. Some acres of indirect herbicide control of noxious weeds would occur during chemical site preparation and release treatments that overlap weeds. All planned noxious weed treatment would be done without herbicides, and would have the same effects as Alternative 3. The risk of spreading weeds through Alternative 4 would be high due to the larger amount of ground disturbance, indirect treatment of weeds with herbicides during reforestation, and the planned treatment of 3,131 acres of known infestations.

Cumulative Effects

Similar to Alternative 1, but in a larger spatial area.

Alternative 5

Direct and Indirect Effects

Alternative 5 is similar to Alternative 1. Differences include; additional acres of reforestation versus natural regeneration and no post-planting broadcast burning, but instead pile burning within plantations thinned to achieve ICO structure and fuels objectives. This would leave far fewer acres of exposed soil resulting in lower potential weed spread. The acres of weeds planned for treatment with herbicide and those indirectly treated with herbicide are the same as Alternative 1. Alternative 5 would have a moderate risk of increasing the chance of weed spread for the same reasons as those presented in Alternative 1.

Cumulative Effects

Same as Alternative 1.

Summary of Effects Analysis across All Alternatives

Action alternatives 1 and 5 have roughly the same affected environment and acreage of invasive plant species across similar treatments (Table 3.06-2). The direct, indirect and cumulative effects are also expected to be very similar. These alternatives are expected to have a moderate risk of spreading invasives. Alternative 4 has a high risk due to its increased amount of ground disturbing activities. Alternative 3 has a high risk of spreading weeds due to a high level of ground disturbance, no indirect benefit of treating weeds through reforestation activities and the use of non-herbicide tools for planned weed treatments. Alternative 2 has a high risk of spreading weeds since no treatments would occur and canopy levels would not be returned to pre-fire levels as quickly.

3.07 RANGE

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

Legislative authorities for administration of the National Forest System range program are shown in FSM 2201 and objectives, policies, and responsibilities are in the FSM 2202 through 2204 and FSM 2230 through FSM 2238 (USDA 2005a). Forest Plan Direction (USDA 2010a) provides current management direction for the range program.

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

Assumptions Specific to Range

- The authorization for livestock grazing and the administration of allotments will not change with any of the alternatives.
- The area proposed for reforestation, thinning, and noxious weed eradication activities reflects the relative degree of impact each alternative will have on permitted grazing in the project area.
- Monitoring will occur during project implementation to inform livestock managers about project effects on grazing use and rangeland resource conditions. Adjustments are not anticipated, but if needed would occur through the regular permit administration process and be coordinated with affected permittees.
- Given sufficient notice, grazing permittees have the ability to manage livestock in ways that minimize potential adverse impacts of project activities (herbicides, site preparation and release) on grazing operations.

Data Sources

The following information was used to describe existing condition and analyze effects on rangeland resources.

- Field visits to project area
- Local professional knowledge
- Project treatment information
- Allotment and unit/pasture boundaries
- Land ownership data
- Post-fire capable rangeland
- Rangeland infrastructure data
- Transportation data

Range Indicators

The following indicators were used to assess the effects of each alternative on rangeland resources.

- Proposed treatment area in each allotment (percent of allotment proposed for treatments)
- Proposed treatment area in capable rangelands within each allotment
- Amount of range infrastructure encompassed by proposed treatments

Range Methodology by Action

Quantitative and qualitative comparisons of the anticipated impacts of each alternative on rangeland resources and the expected potential for moving existing conditions toward Forest Plan desired conditions were used for determining the effects on rangeland resources.

Affected Environment

Existing Conditions

The 2013 Rim Fire affected thirteen grazing allotments to varying degrees depending on the proportion of the allotment burned or fire severity in the burned areas. The following information applies to grazing allotments within the Rim Fire Reforestation project area.

Rangeland Vegetation

Current rangeland vegetation conditions are the combined result of pre-fire conditions and fire effects on the landscape. Some vegetation types burned more severely (chaparral), but species that dominate these plant communities are well adapted to recover from fire. Unburned areas and areas that burned at low severity are in a condition similar to that before the fire. Burned areas are naturally recovering following the Rim Fire, and vegetation condition has shown gradual improvement, even in severely burned areas. The degree of recovery is varied based on environmental factors such as climate, soils and land management activities. Recognizing differences in vegetation types, identifying the stages of recovery and being responsive through changes in management are crucial to facilitating recovery of the burned landscape. Fire can cause a large scale vegetation type conversion to predominantly non-forest vegetation types, with many areas often dominated by brush within a few years following fire. The post-fire flush of palatable and nutritious forage helps to reduce utilization percentages and improve overall rangeland vegetation condition as recovery progresses.

Capable rangeland describes areas of land that can sustain domestic grazing and generally represent the portions of the landscape assumed to be most commonly used by cattle (USDA 2004a). Capable rangeland can be used to compare the relative amount of available grazing lands within allotments. Livestock may graze incidentally in any area of an allotment while moving between capable grazing areas, but tend to spend a larger proportion of time in capable areas. Deerbrush (*Ceanothus integerrimus*) is the predominant local forage species used by livestock in the mid-elevation range of 3,500 to 6,000 feet. Riparian areas and meadows, which occur as patches within the forest mosaic, are also preferred by livestock due to the availability of water, shade and high quality forage. Livestock also feed in forested areas and forest openings where sufficient understory forage exists.

Due to the dramatic increase in shrub-dominated transitory range following fire, capable range has increased significantly in the project area. Forage production has increased dramatically in some areas in large part due to the abundance of deerbrush and other brush species in burned previously forested areas. This increase in livestock browse is desirable from a grazing standpoint, but is generally considered to be temporary as shrubs eventually grow above browse height and parts of the landscape transition over time towards tree-dominated plant communities (Crotteau et al. 2013).

Noxious Weeds

Throughout the United States, weeds in rangeland settings cause an estimated loss of $2 billion annually (Quimby et al 1991). Noxious weeds, such as leafy spurge, knapweed, and yellow star-thistle, can significantly reduce the carrying capacity of grazing lands. Forage can be reduced between 35 and 90% on weed-infested rangelands (USDI 1985). Ecologic costs of weed infestations are many. Weeds can reduce plant diversity, reduce wildlife habitat and forage, alter fire frequency, increase erosion, displace rare or sensitive plant species, and deplete soil moisture and nutrient levels (DiTomaso 2000). High severity fires increase the potential for weed invasion and spread (Keeley et al. 2003). Weed infestations in the project area impact livestock grazing primarily by reducing the quantity and quality of forage. Numerous weed species occur within the project area (3.06 Invasive Species). Table 3.07-1 shows those species with the highest potential to negatively impact rangelands. Johnsongrass, only recently introduced into the project area, is highly invasive and can be toxic to cattle (DiTomaso et al. 2013). Klamathweed, also known as Common St. Johnswort, is known to be toxic, causing photosensitization in most livestock (DiTomaso et al. 2013). Barbed goatgrass and medusahead grass are not toxic, but can cause mechanical injury to livestock, deer and other animals (Peters et al. 1996).

Table 3.07-1 Estimated Acres of Invasive Species in Grazing Allotments

Allotment	Medusahead Grass	Johnson Grass	Barbed Goatgrass	Yellow Star-thistle	Tocalote	Klamathweed	Totals[1]
Jawbone-Rosasco	3,091	385	11	865	444	1	**4,797**
Hunter Creek	62	0	2	8	212	1	**285**
Duckwall	0	0	0	0	0	1	**1**
Middle Fork, Meyer-Ferretti, Curtin	783	44	3	1,364	199	2	**2,395**
Bonds, Bower Cave, Bull Creek	74	0	0	5,313	1,276	12	**6,675**
Westside, Lower Hull, Upper Hull	1	0	1	0	0	0	**2**
Totals (acres)	**4,011**	**429**	**17**	**7,550**	**2,131**	**17**	**14,155**

[1] Totals include overlapping acres.

Allotment Administration

Forest Plan Direction provides standards and guidelines designed to provide for resource conservation and sustainable use of rangelands. Range monitoring is conducted as needed to ensure that grazing management strategies meet objectives for desired conditions. Administration of grazing allotments involves travel on and off roads by Forest Service staff and permittees. Administration of grazing allotments in a post fire landscape may require more frequent travel to and from key areas and range infrastructure. Dead and down trees pose a threat to human safety and make access more difficult for Forest staff and grazing permittees.

Rangeland Infrastructure

Rangeland infrastructure includes fences, water developments (troughs), cattleguards, gates and corrals designed to control livestock movements (timing, duration, and intensity of grazing). Some improvements in the project area, particularly fences, are still damaged and need repair. Over time, dead trees are likely to fall and damage range infrastructure, even after it has been repaired. Dead trees adjacent to fences and troughs pose a safety risk for Forest staff and permittees responsible for repairing and maintaining improvements. Allotment management is more difficult without functioning infrastructure.

Livestock Movements

Livestock move through the allotments throughout the grazing season to find available forage and water. In many burned areas dead standing trees are abundant and have begun to fall. Fallen dead trees have the potential to “jackstraw” inhibiting livestock movements and reducing forage availability. Defective trees may also pose some risk to livestock, as cattle may be injured or killed by falling trees or by an excess of unburned fuel and debris. An abundance of dead material also impedes the ability of permittees to herd livestock and achieve proper distribution.

The allotments in the project area are open range allotments. Livestock frequently travel across and along roads. When vehicles approach, the cattle generally move off of roads and out of the way of the oncoming vehicle. To some extent, fallen dead trees along roadsides have the potential to cause or contribute to vehicle and cattle interactions or collisions.

Environmental Consequences

Direct effects on rangeland resources are directly caused by project implementation. Indirect effects on rangeland resources are in response to the direct effects of treatments or, as with Alternative 2 (No Action), a lack of treatment. Project management requirements (2.02 Alternatives Considered in Detail; 2.03 Management Requirements Common to All Action Alternatives) are designed to mitigate the direct and indirect effects of the project on rangeland resources.

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Table 3.07-2 provides a summary of the Alternative 1 treatments within each allotment.

Table 3.07-2 Alternative 1: Treatments in Grazing Allotments

Allotment	Deer Habitat Enhancement	Natural Regeneration	Noxious Weed Eradication	Reforestation	Thin Existing Plantations	Totals[1]
Jawbone-Rosasco	3,814	951	4,699	9,661	3,813	18,239
Hunter Creek	0	29	247	1,640	5,005	6,674
Duckwall	0	256	56	0	95	351
Middle Fork, Meyer-Ferretti, Curtin	0	2,473	1,594	9,418	2,382	14,273
Bonds, Bower Cave, Bull Creek	0	36	19	13	684	733
Westside, Lower Hull, Upper Hull	0	288	1	190	300	778
Totals (acres)	**3,814**	**4,033**	**6,616**	**20,922**	**12,279**	**41,048**

[1] Totals include overlapping acres

Rangeland Vegetation

Activities proposed for Alternative 1 would have short and long-term impacts to rangeland vegetation. Generally, fuel reduction activities may result in direct short-term negative impacts to understory vegetation, but would result in long-term beneficial effects because they reduce the potential for future high severity fire. Natural regeneration is expected to improve short-term vegetation condition because these areas would be monitored for five years, and reforestation treatments that damage understory vegetation (site preparation and release) would be used only if natural regeneration is inadequate. Deer habitat enhancement treatments would affect only the Jawbone allotment, and may result in short-term negative impacts from site prep, release, and prescribed burning treatments which damage vegetation and can create openings for weeds. Similarly, weed treatments may result in short-term impacts to vegetation because even desirable, non-target species may be killed by burning, grubbing, and herbicides.

Reforestation activities, other than burning, generally negatively affect rangeland vegetation on both a short and long-term basis because they damage understory vegetation within treatment units and favor growth and establishment of trees, which will eventually significantly reduce the shrubs and herbaceous species that are used by livestock. Table 3.07-3 shows reforestation treatments would reduce capable rangeland by 14,089 acres (15.5% of total capable rangeland) in the project area.

Table 3.07-3 Reforestation in Capable Rangeland

Allotment	Capable	Reforestation	Percent Capable
Jawbone-Rosasco	25,670	6,845	27
Hunter Creek	5,667	854	15
Duckwall	3,192	0	0
Middle Fork, Meyer-Ferretti, Curtin	26,506	6,248	24
Bonds, Bower Cave, Bull Creek	10,063	5	0
Westside, Lower Hull, Upper Hull	19,946	137	1
Totals (acres)	91,044	14,089	15.5

[1] Totals include overlapping acres

Reforestation activities would have the most negative affect on rangeland vegetation, including forage production and range capability. Site preparation and release treatments, including subsoiling, would directly reduce forage production and indirectly lead to dominance by tree species. Herbicide applications would kill competing vegetation that could otherwise be used by livestock. Herbicide use would dramatically reduce forage production within reforestation units and potentially in natural regeneration units should these treatments be needed. Reduced forage production may result in localized impacts to rangeland vegetation because livestock use may become somewhat more concentrated in untreated areas; thus, untreated areas are likely to see increased grazing use to some extent. Rangeland vegetation in the Jawbone, Hunter Creek, Rosasco, Middle Fork and Curtin grazing allotments is most likely to be affected by reforestation treatments because the proportions of the allotment areas to be treated are the highest. The effects of reduced forage production within each unit are not likely to significantly negatively impact range vegetation in untreated areas. As stated in the management requirements (2.02 Alternatives Considered in Detail; 2.03 Management Requirements Common to All Action Alternatives), no more than 20% of capable range would be treated in any allotment per year. Because a majority of the project area would not be treated, there should be sufficient available forage in untreated areas to meet livestock nutritional needs.

Alternative 1 includes a planting strategy that limits planting around meadows. No planting would occur within 25 feet of a meadow, and clumps of planted conifers would be evenly dispersed and offset into increasing densities further away from the meadow edge. This would reduce conifer encroachment into meadows and suppression of herbaceous meadow species that may result from competition with planted trees. This meadow planting strategy is an improvement from past reforestation practices that resulted in plantations adjacent to and within meadows and natural openings. Meadow buffers will positively affect rangeland vegetation on a site specific basis.

In general, Alternative 1 has the potential to negatively affect forage production and reduce capable range on a relatively high proportion of capable range within the Jawbone, Hunter Creek, Rosasco, Middle Fork, and Curtin grazing allotments. The overall effects of this alternative on existing rangeland vegetation are detrimental. It should be noted, however, that while the current abundance of early seral shrubs and herbaceous vegetation is considered to be the existing condition, these areas were generally forested before the Rim Fire. Reforestation would occur under this alternative on up to 25,331 acres, whereas about 36,000 acres were forested before the Rim Fire and now have little overstory. While project activities would cause short-term negative impacts to shrubs and grasses in planting units, once the trees are established and release activities stop, these open grown stands will continue to provide far more forage than the more dense mature forest that existed prior to 2013. Rangeland vegetation conditions for grazing would still be a vast improvement over pre-fire conditions due to the abundance of shrubs and herbaceous vegetation both inside and outside planted areas.

Noxious Weeds

Site prep and release activities can dramatically reduce ground cover and temporarily create openings for weeds, but management requirements for noxious weeds would minimize the risk of weed introduction and spread from project activities. Noxious weed eradication, primarily with herbicides applied to larger weed infestations, may be detrimental to desirable range vegetation on a short-term basis.

Table 3.07-4 Alternative 1: Noxious Weed Eradication in Capable Rangeland

Allotment	Medusahead Grass	Johnson Grass	Barbed Goatgrass	Yellow Star-thistle	Tocalote	Klamathweed	Totals[1]
Jawbone-Rosasco	3,091	385	1	241	443	1	**3,777**
Hunter Creek	28	0	2	7	186	1	**224**
Duckwall	0	0	0	0	0	1	**1**
Middle Fork, Meyer-Ferretti, Curtin	772	44	2	499	131	1	**1,449**
Bonds, Bower Cave, Bull Creek	1	0	0	16	1	0	**18**
Westside, Lower Hull, Upper Hull	0	0	0		0	0	**0**
Totals (acres)	**3,892**	**429**	**5**	**763**	**761**	**4**	**5,854**

[1] Totals include overlapping acres.

Table 3.07-4 shows acres of noxious weed eradication using herbicides within capable rangeland under Alternative 1. In particular, noxious weed eradication on the Jawbone Lava Flat have the potential to significantly reduce annual forage production temporarily because Medusahead grass, the main target species, occupies a large expanse of the lava cap and comprises a significant portion of the plant community in some areas. The longer term impacts of noxious weed control and eradication, however, are hugely beneficial to rangeland vegetation condition because native species and other preferred vegetation would be favored by these treatments. Noxious weed eradication is expected to create a more desirable species composition in rangeland plant communities, which is likely to improve forage quantity and quality, vegetation condition, and ecosystem function.

Allotment Administration

Alternative 1 would indirectly impact allotment administration during project implementation. Treatments (herbicide application and mechanical treatments) may require increased efforts on behalf of affected permittees to avoid activities that may alter livestock movements and to ensure proper distribution. During this time, more frequent monitoring may be required to ensure that range standards and guidelines are being met. Fuel reduction activities would result in short-term impacts, but would be beneficial in the long-term because they improve access for permittees and forest staff to perform grazing program administration.

The herbicides proposed for use in Alternative 1 are generally considered safe (when applied according to product labels) for application where livestock use is anticipated; however, grazing restrictions may apply to some herbicides, Clethodim in particular. Clethodim would mainly be used on the Jawbone lava cap, where medusahead grass has invaded a large expanse of annual grassland. Permittees would be provided with herbicide product labels and a schedule of planned treatments. If herbicide grazing restrictions apply, permittees would have the ability to avoid specific areas of herbicide application by timing, herding, salting, or use of temporary fences to prevent livestock grazing in treated areas immediately following application of Clethodim or other herbicides. Herbicides should generally be applied as early in the growing season as possible for maximum effectiveness, which would also maximize the amount of time between application and the beginning of the grazing season. The most likely potential impact to livestock movements and grazing operations would be a voluntary delay in livestock entry onto the allotments to minimize the risk of herbicide exposure or ingestion by livestock. No more than 20% of the capable range within an allotment would be treated per year, and permittees would be given advance notice of herbicide application 8 weeks prior to implementation. Appendix D gives more information about herbicide application rates and Appendix N provides the schedule for noxious weed applications. Overall, Alternative 1 would increase the need for allotment administration, which may indirectly result in reduced capacity for grazing program administration on other allotments on the Forest.

Rangeland Infrastructure

Alternative 1 poses some risk that project activities involving fire or heavy equipment would damage range infrastructure. The potential for damage to range improvements is mitigated by management requirements and project administration. Contracts should include language requiring project activities to avoid damaging functioning range fences and to repair fence damage that results from implementation activities. Infrastructure maintenance needs are not likely to change, but the functioning condition of range infrastructure may improve under Alternative 1 because access may be made easier by site preparation treatments. Site preparation adjacent to range infrastructure would improve safety conditions for persons responsible for infrastructure maintenance and have a positive effect on grazing management.

Livestock Movements

Alternative 1 may result in short-term impacts to livestock movements as a result of activities that may scare livestock (mechanical equipment, crews of workers) and those that are detrimental to rangeland vegetation. During project implementation, livestock are likely to avoid areas where herbs and shrubs have been killed by chemical or mechanical treatment. Noise from heavy equipment operations may cause livestock to be skittish or stressed, making herding and gathering more challenging. This has the potential to disrupt normal livestock movement patterns, but this effect would be localized to areas where activities are occurring. Livestock may either avoid or be attracted to burned areas, depending on site specific recovery, proximity to water, and abundance of palatable forage. Long-term effects to livestock movements would be limited primarily to reforested areas because livestock are less likely to move into or through established plantations in search of forage. Long-term effects are not likely to significantly alter livestock movement patterns because cattle would have the ability to move freely through the allotments and tree spacing would not preclude livestock movements within plantations. Site preparation and prescribed fire treatments would remove downed wood which can impede livestock movement, thereby improving livestock dispersal. The majority of reforestation activities would affect the Jawbone, Rosasco, Hunter Creek, Middle Fork and Curtin allotments because a higher proportion of capable rangeland within these management units would be reforested under this alternative.

CUMULATIVE EFFECTS

Present and reasonably foreseeable actions that affect range are shown in Appendix B and include timber sales, restoration projects, fuels treatments, and herbicide use on public and private lands in the project area. Timber harvest on about 4,000 acres may cause livestock stress, damage understory vegetation, and increase the potential for weed introduction and spread, but longer term effects would be beneficial by reducing the potential for future high severity fire, improving watershed health, and increasing the potential for understory forage production. Recreation and special use activities are unlikely to noticeably affect grazing activities. Fuels treatments would result in short-term site forage loss and can increase the potential for weed spread, but may also increase forage production for several years following treatment and would reduce the risk of future high severity fire. Planned herbicide use on private (15,479 acres) and public lands (up to about 26,500 acres for Alternative 1 would temporarily negatively affect understory vegetation, may require more intensive management by range permittees, and may increase the potential for livestock exposure to chemicals. Restoration actions (aspen stand improvement, meadow restoration, conifer removal, gully, repair, etc.) are generally beneficial for range, but meadow exclosures (fences/barriers) restrict livestock access to forage and/or water and can result in localized negative impacts. Cumulatively, the multitude of projects occurring in the project area would increase the need for program administration and livestock management. Because the effects of these activities are both positive and negative, the cumulative effects of Alternative 1 are expected to be neutral or slightly positive overall for grazing management and rangeland vegetation.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

The following information describes the indirect effects of taking no action under Alternative 2.

Rangeland Vegetation

Alternative 2 would not cause short-term effects to rangeland vegetation from chemical and mechanical treatments that damage rangeland vegetation. Capable rangeland and forage production would not be reduced by treatments that kill competing vegetation or by reforestation. Conversion of rangelands to forests is likely to occur naturally over a longer timeframe in the absence of fire or other disturbance. In areas not utilized by livestock, shrubs may grow rapidly above browse height and become unavailable to livestock. A lack of site preparation, prescribed fire, and plantation thinning increases the potential for indirect detrimental effects to rangeland vegetation, because these treatments reduce the amount of fuels and vegetation that could burn in a high severity fire.

Noxious Weeds

The absence of noxious weed eradication in Alternative 2 is likely to negatively affect rangeland vegetation because weed populations in the project area would continue to expand unabated. Johnsongrass was only recently introduced in the Rim Fire area and has the potential to expand considerably, displacing native species and negatively affecting previously weed-free ecosystems. On the Jawbone Lava Flat, large expanses of noxious weeds will continue to negatively impact plant diversity, wildlife habitat, forage quality, and ecosystem function.

Allotment Administration

Alternative 2 is not likely to affect allotment administration activities. Site preparation activities, which would benefit allotment administration by improving livestock movement, would not occur; however, there would be no need for increased allotment administration as a result of project activities that damage vegetation and affect livestock movement. The capacity for allotment administration outside of the project area would not be reduced.

Rangeland Infrastructure

A beneficial effect of Alternative 2 would be no potential impacts to infrastructure during implementation. Conversely, safety conditions for persons responsible for infrastructure maintenance would not be improved and the existing hazards (standing dead trees) would not be treated during site preparation activities.

Livestock Movements

Alternative 2 would not implement activities that can scare livestock and disrupt livestock movement patterns; however, treatments that would improve livestock access (site preparation, plantation thinning, and prescribed fire) would not occur. The overall effects on livestock movements would be neutral.

CUMULATIVE EFFECTS

Present and reasonably foreseeable actions may cause livestock stress, damage understory vegetation, and increase the potential for weed introduction and spread, but longer term effects would be beneficial. Recreation and special use activities are unlikely to noticeably affect grazing activities. Rim Recovery fuels treatments will result in short-term site forage loss and can increase the potential for weed spread, but may also increase forage production for several years following treatment and would reduce the risk of future high severity fire. Herbicide use on private (15,479 acres) would temporarily negatively affect understory vegetation, may require more intensive management by range permittees, and may increase the potential for livestock exposure to chemicals. Restoration actions (aspen stand improvement, meadow restoration, conifer removal, gully, repair, etc.) are generally beneficial for range, but meadow exclosures (fences/barriers) restrict livestock access to forage and/or water and can result in localized negative impacts. Cumulatively, the multitude of projects occurring in the project area would increase the need for program administration and livestock management. Because the effects of these activities are both positive and negative, the cumulative effects of Alternative 2 would generally be neutral or beneficial for grazing management and rangeland vegetation because additional chemical and mechanical treatments that damage vegetation, reduce forage, and stress livestock would not occur. Potential negative cumulative effects are associated with dramatically reduced or lack of reforestation and noxious weed eradication.

Alternative 3

DIRECT AND INDIRECT EFFECTS

Alternative 3 would treat same acres as Alternative 1, but would not use any herbicides to accomplish reforestation or noxious weed eradication, only hand applications. Table 3.07-2 provides a summary of the Alternative 3 treatments within allotments.

Rangeland Vegetation

Alternative 3 would negatively affect capable rangeland vegetation on up to 14,871 acres. Site preparation and release activities using hand grubbing or mechanical equipment are generally more detrimental to rangeland vegetation than herbicides because they not only kill shrubs and herbaceous vegetation, but they negatively affect soil structure and create bare soil. Whereas chemical site preparation, release, and weed eradication treatments kill vegetation, mechanical treatments remove the vegetation, exposing bare soil and creating the potential for erosion and establishment of early seral or undesirable species. Even with management requirements, Alternative 3 is likely to result in soil loss and reduced soil productivity in addition to weed introduction and spread, which may translate into reduced forage production and range capability.

Alternative 3 also differs from Alternative 1 in terms of fuelbreak planting design: Alternative 3 fuelbreaks would be 250 feet wide and average 151 trees per acre, whereas under Alternative 1 fuels breaks would be 330 feet wide and average 176 trees per acre. Release would be accomplished by hand grubbing to remove competing vegetation and the fuelbreaks would be maintained with mastication where brush got above one-foot tall. Wider fuelbreaks with fewer trees are more likely to support understory vegetation once trees are established and release treatments are no longer necessary. Since ridges tend to be a drier landscape position and cattle use of these areas is often limited, the wider fuelbreaks are not likely to contribute in meaningful ways to forage production or vegetation condition.

Similar to Alternative 1, Alternative 3 is likely to negatively affect forage production and reduce range forage on a relatively high proportion within the Jawbone (59.1%), Hunter Creek (51.7%), Rosasco (43.7%), Middle Fork (39.5%) and Curtin (32.1%) grazing allotments. The overall effects of Alternative 3 on rangeland vegetation are detrimental.

Noxious Weeds

Table 3.07-5 shows Alternative 3 would treat only a third of the acreage of noxious weeds as Alternative 1. Noxious weeds in the Duckwall, Bonds, Bower Cave, Bull Creek, Westside, Lower Hull and Upper Hull allotments would not be treated under this alternative. Non-chemical weed eradication methods are less likely to be effective in eradicating target weed populations than a treatment program including chemicals. In addition, due to the larger acreage treated by heavy equipment, Alternative 3 would result in an increased potential for weed introduction and spread. Management requirements are aimed at minimizing the potential for weed introduction and spread; however the potential for weed introduction and spread for Alternative 3 is higher than described for Alternative 1. Alternative 3 is both more likely to introduce weeds and less likely to reduce or eradicate weeds, and so would not be as beneficial as Alternative 1 in controlling or eradicating rangeland weeds.

Table 3.07-5 Alternative 3: Noxious Weed Eradication in Capable Rangeland

Allotment	Medusahead Grass	Johnson Grass	Barbed Goatgrass	Yellow Star-thistle	Tocalote	Klamathweed	Totals[1]
Jawbone-Rosasco	2,589	13	1	177	1	1	**2,782**
Hunter Creek	1	0	1	0	1	1	**4**
Duckwall	0	0	0	0	0	0	**0**
Middle Fork, Meyer-Ferretti, Curtin	1	0	2	0	0	1	**4**
Bonds, Bower Cave, Bull Creek	0	0	0	0	0	0	**0**
Westside, Lower Hull, Upper Hull	0	0	0	0	0	0	**0**
Totals (acres)	**2,591**	**13**	**4**	**177**	**2**	**3**	**2,790**

[1] Totals include overlapping acres.

Allotment Administration

Alternative 3 would indirectly impact allotment administration during project implementation. Treatment activities may require more frequent monitoring to ensure that range standards and guidelines are being met. Mechanical treatments may require increased efforts on behalf of affected permittees to ensure proper distribution and avoid treatments that damage vegetation and alter livestock movements. Fuel reduction activities would result in short-term negative impacts, but would be beneficial in the long-term because they improve access for permittees and forest staff to perform grazing program administration.

Permittees may avoid specific areas of mechanical disturbance by using grazing management techniques, including timing, herding, or salting. No more than 20% of the capable range within an allotment would be treated per year, and permittees would be given an implementation schedule to facilitate avoidance of project activities, if needed.

Rangeland Infrastructure

Range infrastructure is more likely to be damaged by Alternative 3 due to the increased use of heavy equipment to implement site prep and release treatments, but repairing damaged facilities is required under this alternative and is standard for all Forest Service contracts.

Livestock Movements

Alternative 3 may impact livestock movements because project activities could scare livestock and damage rangeland vegetation. Due to the increased use of heavy equipment, this alternative is the most likely to stress and disturb livestock. Otherwise, the effects of Alternative 3 on livestock movements are the same as described for Alternative 1.

CUMULATIVE EFFECTS

The cumulative effects of this Alternative are similar to those described under Alternative 1. The use of heavy equipment is more likely to contribute to altered livestock movements when combined with other actions. Alternative 3 also treats fewer acres of noxious weeds while increasing the potential for weed introduction and spread. Alternative 3 is slightly less beneficial and slightly more detrimental than Alternative 1 from a cumulative effects standpoint.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Table 3.07-6 provides a summary of the Alternative 4 treatments within allotments.

Table 3.07-6 Alternative 4: Treatments in Grazing Allotments

Allotment	Deer Habitat Enhancement	Natural Regeneration	Noxious Weed Eradication	Reforestation	Thin Existing Plantations	Totals[1]
Jawbone-Rosasco	445	0	3,447	1,376	3,813	**9,081**
Hunter Creek	0	0	12	13	5,005	**5,030**
Duckwall	0	0	1	0	95	**96**
Middle Fork, Meyer-Ferretti, Curtin	0	0	249	1,445	2,382	**4,076**
Bonds, Bower Cave, Bull Creek	0	0	1	0	684	**685**
Westside, Lower Hull, Upper Hull	0	0	1	22	300	**323**
Totals (acres)	**445**	**0**	**3,711**	**2,856**	**12,279**	**19,291**

[1] Totals include overlapping acres

Rangeland Vegetation

The effects of Alternative 4 on rangeland vegetation would be the same as described for Alternative 1, but would occur on only 20% of the area. The effects to rangeland vegetation from site preparation and release with glyphosate would be the same as described for Alternative 1, but would occur on only up to 4,012 acres. Because the treatment activities would be much less extensive, livestock concentration in untreated areas is much less likely to occur. Also, because far fewer acres would be converted to plantations, negative effects on long-term forage production would be dramatically reduced from Alternatives 1 and 3. Unplanted early seral areas would eventually regenerate naturally into forests in the absence of disturbance, but this would take longer without active reforestation treatments. The increased use of prescribed fire would increase the potential for short-term damage to rangeland vegetation, but would be beneficial in the long-term by maintaining early seral understory vegetation types in burned areas, which tend to provide nutritious and palatable forage for livestock.

Noxious Weeds

Because Alternative 4 treats noxious weeds without the use of herbicides, the effects of this alternative are the same as described for Alternative 3.

Allotment Administration

The effects of Alternative 4 on allotment administration would be the same as described for Alternative 3, but would occur to a lesser extent because only about 20% of the area would be treated. The need for allotment administration would increase only slightly, and effects to livestock management would be minimal.

Rangeland Infrastructure

The effects of Alternative 4 on range infrastructure are similar to those described for Alternative 1, but Alternative 4 affects only 20% of the area as other alternatives and so is 80% less likely to result in damage to range infrastructure. This alternative poses a greater risk that prescribed fire may damage range infrastructure, but the intensity of prescribed fires is assumed to be less likely to cause damage than an uncontrolled fire such as the Rim Fire. Like the other alternatives, infrastructure that is damaged by project activities would be repaired.

Livestock Movements

Alternative 4 may result in short-term impacts to livestock movements. Livestock are likely to avoid areas where vegetation is killed by mechanical treatment. Heavy equipment operations may cause livestock stress, making herding and gathering more challenging. Because this effect is localized to areas where activities are occurring, and because there would be significantly fewer acres treated with mechanical equipment, this alternative is less likely to significantly alter livestock movements than Alternatives 1 or 3. Alternative 4 includes more prescribed fire than other alternatives. Livestock may either avoid or be attracted to burned areas, depending on site specific recovery, proximity to water, and abundance of palatable forage. Long-term effects to livestock movements would be limited primarily to reforested areas because livestock are less likely to move into or through established plantations in search of forage. Long-term effects are not likely to significantly alter livestock movement patterns because cattle would have the ability to move freely through the allotments.

CUMULATIVE EFFECTS

The cumulative effects of reforestation activities for Alternative 4 are similar to those described for Alternative 1, but occur on a much smaller scale due to the smaller acreage that would be treated. The cumulative effects of noxious weed eradication for Alternative 4 are similar to those described for Alternative 3. Alternative 4 treats fewer acres with herbicides and converts fewer acres to plantations, dramatically reducing the cumulative impacts to range.

Alternative 5

DIRECT AND INDIRECT EFFECTS

Alternative 5 includes the same treatment areas within allotments as Alternative 1 (Table 3.07-2).

Rangeland Vegetation

The effects of Alternative 5 on rangeland vegetation are similar to those described for Alternative 1, with the exception of range vegetation adjacent to meadows. Alternative 5 differs from Alternative 1 in that the planting strategy around meadows would result in a 7 by 14-foot spacing of planted conifers 25 feet from meadows. This planting strategy does not provide for meadow vegetation or meadow hydrology as much as the Alternative 1 meadow buffer planting strategy. While the 25 foot buffer is beneficial for rangeland vegetation, the denser planting outside of the 25 foot buffer is more likely to contribute to conifer encroachment and other long-term negative effects to meadows and herbaceous vegetation. This alternative would, however, create the desired tree numbers during thinning at year 7 if the surviving trees exceed this amount adjacent to meadows. This would help prevent negative effects to rangeland vegetation adjacent to meadows.

Noxious Weeds

Same as Alternative 1.

Allotment Administration

Same as Alternative 1.

Rangeland Infrastructure

Same as Alternative 1.

Livestock Movements

The effects of Alternative 5 on livestock movements are similar as described for Alternative 1, with the exception that Alternative 5 does not include prescribed fire in new plantations. The lack of prescribed fire is more likely to negatively affect livestock movements than other action alternatives.

CUMULATIVE EFFECTS

Same as Alternative 1.

Summary of Effects Analysis across All Alternatives

The effects of each alternative are compared against the relative area proposed for treatment within grazing allotments and the amount of capable range in treatment areas. Table 3.07-7 displays a summary of this information for all alternatives.

Table 3.07-7 Comparison of Alternatives: Treatments within Allotments and Capable Rangelands

Treatments	Alternative 1 **Allotment**	Alternative 1 **Capable**	Alternative 2 **Allotment**	Alternative 2 **Capable**	Alternative 3 **Allotment**	Alternative 3 **Capable**	Alternative 4 **Allotment**	Alternative 4 **Capable**	Alternative 5 **Allotment**	Alternative 5 **Capable**
Deer Habitat Enhancement	3,814	2,936	0	0	3,813	2,936	3,571	2,750	3,814	2,936
Natural Regeneration	4,033	2,377	0	0	4,033	2,377	0	0	4,033	2,377
Noxious Weed Eradication	6,616	5,182	0	0	3,711	3,117	3,711	3,117	6,616	5,182
Reforestation	20,922	14,089	0	0	20,922	14,089	2,955	1,953	20,922	14,089
Thin Existing Plantations	12,279	7,824	0	0	12,279	7,824	12,279	7,824	12,279	7,824
Totals[1] (acres)	**47,664**	**32,408**	**0**	**0**	**44,758**	**30,343**	**22,516**	**15,644**	**47,664**	**32,408**

[1] Totals include overlapping acres

Alternative 4 is generally the most beneficial action alternative from a range standpoint because it favors shrubs and herbaceous vegetation. On the other hand, while Alternatives 1 and 5 would result in more damage to shrubs and herbaceous vegetation, these alternatives are more likely to be effective in controlling and/or eradicating weed populations. Alternative 3 has the potential to be most detrimental because the emphasis on mechanical treatments is more likely to disturb livestock and damage range vegetation, and at the same time is more likely to result in weed introduction and spread and less likely than other alternatives to control or eradicate noxious weeds. All action alternatives would to some extent reduce the risk of future high severity fire by removing fuels through site preparation, creating fuel break structures during initial planting or pre-commercial thinning, and using prescribed fire. While project site preparation, release, and weed treatments will result in short-term negative impacts to rangeland vegetation and program administration, none of the alternatives are likely to result in significant long-term changes because a majority of the project area would not be treated and historically these acres were forested with very little vegetation in the understory. Even with these negative impacts, the range condition would remain improved and forage would be more abundant than pre-fire conditions.

3.08 RECREATION

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

Various Federal laws, FSM direction, as well as the Forest Plan provide the framework for the Rim Reforestation project. The components of this regulatory framework are outlined below.

- **Forest Plan**: Contains both Forestwide and management area specific direction. The specific Forest Plan goal for Recreation is to: Provide a wide range of recreation opportunities directed at various experience levels to meet current and projected demand, including campgrounds, hiking trails, picnic areas, off-highway vehicle (OHV) trails, etc. (USDA 2010a).
- **FSM 2300 Recreation, Wilderness and Related Resource Management**: guides management of recreation resources on NFS lands; it contains wide-ranging goals and objectives that serve as the overall framework for managing recreation.
- **Recreation Niche**: The Stanislaus National Forest developed a recreation niche statement and setting map through the Recreation Facility Analysis process (USDA 2007). The niche statement describes the unique characteristics, opportunities, settings and activities of the Forest's recreation program. The statement describes a full range of overnight opportunities, and states that, family oriented overnight activities are most popular and in highest demand, with a much higher-than-average participation by children. With easy access for urban visitors, the Forest is seen as an oasis to escape from winter fog, summer heat and urban life. An increase in visitation of 42% over the next 20 years is projected.

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

The potential direct and indirect effects to recreation were considered within the Rim Reforestation project area. The direct effects would be short-term and temporary, occurring during project implementation. The long-term indirect effects would be related to ecosystem restoration, changes in visual qualities, and other items within the project area that would influence recreation opportunities.

The temporal bounds of the recreation analysis are generally dependent on the lasting effects of project activities. Effects can be either short-term in nature or long-term. Short-term effects are impacts from project activities that are expected to last up to 5 years. These would include disturbances associated with implementation of the proposed activities as well as impacts that would endure beyond implementation, up to five years. Long-term effects are those projected to endure beyond 5 years.

Assumptions Specific to Recreation

- Forest recreation use is expected to continue based on nearby urban population growth and demand will continue for recreation opportunities.
- National Visitor Use Monitoring (NVUM) data is accurate.
- Implementation of proposed activities will be completed using the management requirements detailed in Chapter 2.03.
- While Forest recreation visits occur year round, the majority of them occur in the summer.

Data Sources

- Stanislaus GIS Library
- National Visitor Use Monitoring (NVUM) data (USDA 2014c)
- Recreation Facility Analysis (USDA 2007)
- Recreation Opportunity Spectrum (ROS), Management Area and project area GIS maps
- Data from the Rim Recovery EIS (USDA 2014)

Recreation Indicators

Temporary loss of recreation opportunity: displacement of users, or a change in recreation experience due to vegetation treatments/prescribed fire activities (i.e. temporary closure of areas/visitors avoiding the area during the vegetation treatments/prescribed fire).

- Measure: Effects lasting up to 5 years in duration

Long-term loss of recreation opportunity: chronic displacement of users, or permanent changes in recreation experience due to changes in scenery following the vegetation treatments/prescribed fire that affect the recreation setting, long-term closures, loss of trail opportunities from impacts of prescribed fire (increased maintenance shortfalls, erosion and downed trees) or other actions related to the project.

- Measure: Effects lasting more than 5 years in duration

Recreation Methodology by Action

The recreation indicators compare the effects of the alternatives on recreation access and opportunities. The analysis discusses the changes in recreation opportunities as a result of each alternative. The recreation analysis objective is used to evaluate how each alternative would enhance or diminish recreation access and opportunities in the short and long-term.

Affected Environment

Existing Conditions

VISITOR USE

Before the Rim Fire, recreation within the project area included OHV use, passenger car driving, rafting, boating, hunting, swimming, mining, wood cutting, camping (dispersed and developed), hiking, cycling (mountain and road), fishing, backpacking, horseback riding and limited winter sports. Many of those opportunities are once again available for visitor use due to hazard tree removal. Some of the traditional activities that have been attractive to the forest visitor will be less attractive because of the fire. Dispersed camping may be less attractive without the canopy of trees, as an example, while water features remain attractive.

The Rim Fire changed some recreation opportunities. The Spinning Wheel Closure Order STF 2014-13 went into effect in November of 2014 and is set to end in November 2015. Public access is prohibited into this area due to instability of soils and the need for vegetation to establish (USDA 2014a). Visitor use estimates for the entire Forest are based on the NVUM survey conducted in 2012, prior to the Rim Fire, and updated in April of 2014 (USDA 2014c). Recreation use on the Stanislaus National Forest for this period was estimated at 1,817,200 National Forest visits and 2,100,300 site visits. The most recent NVUM data shows the following recreation and visitation patterns:

- Roughly 30% of visitation is from within 50 miles of the Forest. There are relatively few visits from greater distances; only about 10% report traveling more than 200 miles.
- Average visitation duration is about 21 hours, though more than half of visits last less than 6 hours
- Infrequent visitors (those who visit at most 5 times per year) account for about 53% of all visits

- About 10% of visits are from people who report visiting more than 50 times per year
- The activities with the highest participation rates include hiking/walking, relaxing, viewing natural features and viewing wildlife.
- The most hours spent doing an activity were developed and dispersed camping, resort use and backpacking.

Visitors were asked to select one of several substitute choices, if for some reason they were unable to visit this national forest. Choices included going somewhere else for the same activity they did on the current trip, coming back to this forest for the same activity at some later time, going someplace else for a different activity, staying at home and not making a recreation trip, going to work instead of recreating, and a residual 'other' category). The largest percent (38%) said they would go elsewhere to participate in the same activity.

NVUM does not state the time of year when the majority of visitors come to the forest. However, many recreation facilities close in mid-October, limiting some opportunities in winter. The main activities reported by visitors through the NVUM process indicate that the majority of visitors arrive in the summer months when those opportunities are available.

Outfitter-guides are currently authorized to operate within the project area. The current special uses database shows nine outfitters on the Mi-Wok and Groveland Ranger Districts, but whether they are utilizing areas within the Rim Fire is unknown (USDA 2014d). Outfitter-guide permits constantly change and there may be less or more outfitters permitted in 2016. Current uses include canoeing, hiking, rafting, fly fishing, shuttle services, sunset tours, weddings, biking and kayaking.

OPPORTUNITY

The Forest Service uses the ROS to inventory and describe the range of recreation opportunities available based on the following characteristics of an area: physical (characteristics of the land and facilities), social (interactions and contact with others), and managerial (services and controls provided). The recreational settings are described on a continuum ranging from Primitive to Urban. The attributes of ROS are the physical (type of access, remoteness, size), the social (user density, encounters), and the managerial (type of facilities, visitor management and naturalness) characteristics of the place (USDA 1986).

The majority of the project area falls within the Roaded Natural and Semi-Primitive Non-Motorized classes. Table 3.08-1 shows the direction for management of these two classes.

Table 3.08-1 Recreation Opportunity Spectrum Classes within the Rim Reforestation project area

ROS	General Direction	Standards and Guidelines
Semi-Primitive Non-Motorized **NMFPA**[1]	Manage the area so that on-site controls are minimized and restrictions are subtle. Provide a range of semi-primitive non-motorized recreation opportunities and experiences.	Meet the ROS objective of Semi-primitive Non-motorized. Interaction between visitors is low but there is evidence of other users. Motorized use is normally prohibited, except for: 4N80Y, 5N02R (NMFPA). Resource improvements will normally be limited to minimum, unobtrusive facilities.
Roaded Natural	Manage the area so there is only moderate evidence of the sights and sounds of man. Provide a range of roaded natural recreation opportunities and experiences.	Meet the ROS objective of Roaded Natural. Interaction between users is usually low to moderate with evidence of other users prevalent. Resource modification practices are evident. Conventional motorized use is provided for in construction standards And facilities designs. A full range of other resource activities is permitted to the extent that the general practice description is met.

[1] NMFPA=Non-motorized Forest Plan Amendment (USDA 2010a, p. 2)

Developed Recreation Opportunities

Developed recreation sites provide infrastructure which typically include running water, structures, vault toilets, signage, barrier posts, interior roads, campfire rings, grills and picnic tables. Some of these sites are managed under special use permits. Developed campgrounds within the affected area are Dimond O, Lost Claim, Lumsden Bridge, Lumsden, South Fork, Sweetwater and Cherry Valley. Upper and Lower Carlon, Middle Fork, and Rainbow Pool Day Use Areas, Rim of the World Vista, Cherry Creek and Merals Pool Boat Launches are also found within the Rim Fire perimeter. Other developed recreation sites under special use permit within the Rim Fire perimeter include Berkeley-Tuolumne Camp, Peach Growers Recreational Residence Tract, and San Jose Camp. A majority of the Berkeley-Tuolumne Camp was destroyed in the Rim Fire and is currently not available for use. San Jose Camp received some fire damage, and a vault toilet was burned at the South Fork Campground. Camp Tawonga is a privately owned camp that is accessed by Cherry Lake Road or Evergreen Road and Forest Route 1S02 (Recreation Report).

Dispersed Recreation Opportunities

Touring, or driving for pleasure by motorized vehicle, is a dominant recreation activity. Hunters, anglers, campers, picnickers, hikers, bikers, wood cutters, forest product gatherers, sightseers, bird watchers, nearby residents, rock climbers, spelunkers, kayakers, boaters, swimmers, target shooters and other recreationists also travel to their activity along forest roads. The journey to and from the activity is part of the recreation experience.

Camping often serves as a base for many other activities. Many participants enjoy camping in trailers, RVs, campers, and in tents near their vehicle. Outside of developed campgrounds, these "camps" are often established along roads or on short spurs off these roads.

Dispersed recreation opportunities include non-motorized system trails and motorized recreation opportunities. The project area provides a variety of dispersed recreation opportunities that include 475 inventoried dispersed campsites. Over 6,650 acres of treatment are proposed within 0.25 mile of the inventoried dispersed camps in the action alternatives reviewed as part of this analysis. Dispersed campsites with improvements and concentrated use areas within the Rim Fire perimeter include Camp Clavey, Cherry Borrow, Cherry Valley, Joe Walt Run, and Spinning Wheel.

Non-motorized system trails include Andresen Mine, Carlon Falls, Hamby, Golden Stairs, Humbug/Duluke, Indian Creek, Kibbie Ridge/Huckleberry, North Mountain, Preston Falls, Tuolumne River Canyon, West Side Trail, and Lake Eleanor. Some trails access various points of interest along the Tuolumne Wild and Scenic River corridor and serve as important emergency access points for river users. Wilderness trailheads within the project area provide access to trails in Yosemite and Emigrant Wildernesses.

Motorized recreation opportunities typically provide a variety of settings and a diversity of OHV trails varying in length, degree of difficulty, and access to other recreation opportunities. Motorized Recreation Areas include Jawbone Pass, Pilot Ridge, Tuolumne Rim, Two-mile/Middle Clavey/Reynolds Creek, and West Side Rail Tour (Recreation Report).

Environmental Consequences

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Effects to visitors are often difficult to quantify, as visitor behavior and acceptance of management activities vary greatly by the individual. Some generalizations based on visitor use patterns can be made.

People would likely see treatment activities or see the effects of them, especially in popular areas like the units near the Rim of the World Vista or along Highway 120. The presence of a crew in the field may be dictated by the activity type, species being treated or planted, the method used, and the optimal time to administer the treatment. However, in some site-specific, popular locations, visitors may be temporarily displaced if they do not wish to recreate where treatments are taking place. This could occur where chemicals are being applied or trees are being thinned or planted. Some sites could be closed to short-term use for public safety while herbicide is being applied or where active thinning or burning is occurring.

In addition, visitors may choose to avoid areas during prescribed burning, thinning or spraying activities even if those areas are not closed to public use. Commercial outfitters operating in the area during project implementation may also be directly affected by limited access or trail closures. Others may choose to avoid certain areas during times of smoke, thinning or herbicide spraying, particularly those who use roads (biking, touring). Adjustments to certain permits may need to be made during this time.

Trucks and other equipment utilizing public travel routes have the potential to increase traffic congestion and negatively affect the driving experience users. Since “driving for pleasure” is an identified recreation use within the project area, this user group, as well as those traveling to recreation destinations could be affected. OHV riders could also encounter vehicle traffic and activities along Forest roads which could cause delays or changes in their preferred routes.

The proposed vegetation treatments would cause temporary, but not permanent, changes in the some areas designated as Semi-Primitive Non-Motorized ROS. The objective of low interaction between visitors and subtle restrictions and controls would not always be met. However, no long-term changes to the ROS in the project area are expected.

A short-term direct effect during project management activities could be temporary Forest closures implemented to protect the public from safety hazards associated with weed spraying and operation of mechanical equipment. These closures would reduce the public’s opportunity to access limited areas of public land for dispersed recreation for up to 24 hours. Advanced signage and public outreach would notify as many people as practical of proposed closure periods ahead of time, allowing them to make alternate recreation access plans. Similarly, management activities within or adjacent to developed recreation facilities have the potential to negatively affect visitor’s recreation experience. The action alternatives include a measure to manage the timing of fuels management activities when practical to avoid weekends when visitation rates are anticipated to be higher.

Herbicide Use and Noxious Weed Eradication

Visitors could notice the effects of herbicide use for site preparation, release, and noxious weed treatments, because browned out vegetation might be obvious. This evidence of treatment activities and effects would reduce the sense of naturalness that some visitors expect from a national forest. Weed treatments would not be noticed the following growing season when the residual live, green native vegetation dominates the view. Those who most value natural conditions would likely tolerate use of herbicides if treatments show rapid and significant success in promoting conifer growth and reducing noxious weeds. Visitors would be able to easily avoid the areas actively being sprayed by crews. Those visitors who oppose the use of herbicide, however, would be reluctant to return to the treated areas. The main effects would be to visitors who travel off trails, hunters, those who seek isolated dispersed campsites and harvesters of forest products. Visitors seeking forest products, such as morels, may avoid areas they have used in the past due to concerns about their health. Indirect effects of herbicide treatments could include a greater concentration of visitors in non-treated areas.

Reforestation

Many of the proposed reforestation units are not located in areas where visitors congregate. Exceptions include units within a quarter mile of Sweetwater Campground, Spinning Wheel, and Rainbow Pool, Dimond O Campground, Lost Claim Campground, the privately owned Camp Tawonga, Middle Fork picnic area, and Peach Growers. At these popular locations, implementation activities could temporarily impact recreation as described under prescribed fire and herbicide use. Impacts would be directly related to which type of adaptive management is used in the units.

Reforestation could make hiking cross-country more difficult due to high shrub cover around years 15-20. Tree density is not expected to hinder non-motorized cross-country travel due to the low density of trees per acre and expected tree mortality. People who enjoy this activity could be displaced to other areas; however, there would still be many places for this type of activity available on the forest.

The use of machinery is proposed in reforestation units for site preparation. Feller-bunchers, excavators and tractors used for removing biomass and piling, shredding or deep tilling would cause continuous noise in the immediate area. The main impacts would be to visitors wishing to camp, picnic, or enjoy nature in the vicinity. Those visitors passing through enroute to destinations could be temporarily inconvenienced by delays on roads.

Hand cutting, hand piling or jackpot burning could also occur in these units. The impacts to recreation are similar to those discussed below in the prescribed fire section.

Prescribed Fire

The direct impacts to recreation from the prescribed burning activities during project implementation would be the sights and sounds of people and equipment, including chainsaws and vehicles, and smoke in the air. Smoke in the air during the prescribed burns may have a direct affect to the quality of the recreation experience within the project area and in the adjacent dispersed camping areas by temporarily reducing air quality and visibility (3.02 Air Quality). Some forest roads may be affected by smoke and this could affect driving opportunities.

Smoke from pile burning would result in short-term effects in portions of the project area after initial site preparation or thinning has occurred and slash piles are treated. Effects could include user dissatisfaction, user displacement, and temporary reduction in setting qualities due to smoke obscuring the surrounding visual quality. Pile burning is often completed on the day of ignition, but the effects could last longer if there are large fuels present in piles.

Smoke from understory burning would be more obvious, since in some cases entire units would be burned. The effects would be less concentrated as pile burning, but would be spread over a larger area and depending on the fuel, humidity and prescription; smoke could linger for several days. Large logs and snags could smolder and burn for indefinite periods.

Thin Existing Plantations

Noise, dust and increased traffic on forest roads would be expected during thinning treatments. The direct impacts to recreation from the thinning activities would be to the sights and sounds of equipment including chainsaws. Indirect effects to recreation would result from changes to the appearance of the units following the thinning activities. These changes could be perceived as beneficial or negative, depending on the viewer. Thinning could create favorable conditions for dispersed recreation and enhance hunting experiences for some. Other visitors could feel a loss of “sense of place” as conditions change in site specific areas from what they are used to experiencing.

Comparatively few studies have been conducted on public perceptions of mechanized thinning to reduce hazardous fuels; however, some insight can be gained from the literature assessing attitudes toward alternative harvesting techniques. Not surprisingly most studies found that people preferred stands with little or no modification over highly manipulated forest stands. However, many visitors would be unable to tell the difference between plantations and natural stands in several years.

Several studies have identified a greater level of sophistication among fire-affected communities in both their understanding and acceptance of fire management techniques when compared to the general population. Additional work in fire-prone areas indicates a number of similar factors influence public support for fuel treatments despite geographic and economic differences. Though treatments could be ongoing, visitors who are aware of the drivers behind these treatments may be more willing to recreate in these areas rather than be displaced by them (Shindler and Toman 2003). Educational messages on the need for treatments could influence visitor acceptance and behavior in this area.

Cumulative Effects

Past human activities and natural disturbance processes influenced the current condition of the project area and continue to affect the vegetation structure, spatial arrangement and pattern, composition and diversity, natural processes (such as fire), and movement towards increased forest resiliency and function.

Recreational activities such as hunting, camping, hiking, OHV travel on primitive roads and limited snowmobiling and cross-country skiing in the winter are expected to continue within the analysis area. Other ongoing and reasonably foreseeable activities that would occur within the analysis area include hazard tree removal, weed treatments, road and trail maintenance, commercial guided recreation and special events, firewood cutting and continued use of grazing allotments. All of these activities, when added to the activities proposed in the Rim Reforestation project have the potential to cumulatively affect the recreation experience within the project area. The primary impacts would be due to the increased presence of people, vehicles and associated noise that would directly affect the ability of visitors to enjoy their desired recreation experience, and may lead to the short-term displacement of visitors who choose to avoid the area during implementation of the various activities. When considered with the recent Rim Recovery project, portions of the project area may appear crowded with workers and equipment for the several years that it takes to complete treatments.

The long-term impacts of ongoing and reasonably foreseeable activities, when added to the activities proposed in the Rim Reforestation project, have the potential to cumulatively impact the recreation users. Most of these effects would be beneficial because they would increase the resiliency of forest conditions, and reduce the risk of potential negative impacts from severe wildfire, therefore, maintaining the recreation settings currently valued by the public. However, due to the length and widespread level of activities, lasting over many years, there could be long-term changes to recreation patterns. Fire not only changes the landscape; it changes how people move through it based on their preferences. Often people do not wish to recreate in recently burned areas, and it is expected that shifting of recreation to other areas is likely to occur.

The current and planned vegetation management treatments cumulatively would result in improvements in forest health and sustainability that are large and widespread. In the event of a wildfire, or insect infestation the restored forest would likely experience more typical low severity fire and small scale insect infestation. This would indirectly benefit recreation in the long-term.

Alternative 2 (No Action)

Direct and Indirect Effects

This alternative would result in no short-term or direct effects to the recreation resources, access or quality of recreation experience within the project area. Existing patterns of recreation use are expected to remain, and to increase in volume over time. Closures for safety could continue, however, and these areas would be unavailable for visitor use.

Visitors' experience may be diminished if they are aware of weeds. Weeds can negatively affect a wide array of environmental attributes that are important to support recreation, including but not limited to soil quality, water quality and quantity, plant diversity, availability of forage and cover, and animal diversity and abundance (Eiswerth et al. 2005). Weeds could establish in some dispersed sites, limiting the availability of that area for recreation. However, those visitors who oppose chemical treatments would be more likely to recreate in an area where this type of treatment would not occur.

The natural recolonization of a fire area could be a draw for some who are interested in this process. Some areas with seed trees that survived the Rim Fire are producing regeneration; this could be interesting to visitors and an educational look at benefits of fire. However, there are many areas that experienced high burn severity and regeneration is currently occurring in the form of manzanita, oak and deerbrush. These shrubs can be difficult to pass through and off-trail hikers and hunters would avoid those areas.

In addition, visitors may avoid the areas that do not naturally recolonize with conifers, since shade and the views they are accustomed to or desire would not be present. This avoidance could persist for decades.

CUMULATIVE EFFECTS

Cumulative effects are expected to be limited to those areas where closures or subsequent fires could cause changes to recreation patterns. Without reforestation activities, the vegetation that colonizes the fire area could cause long-term changes in how visitors distribute themselves across the landscape, and in combination with other projects occurring in the same area, would incur shifts in how people experience the Forest, particularly off-trail users.

Alternative 3

DIRECT AND INDIRECT EFFECTS

The main differences between Alternative 1 and 3 include the lack of herbicide use and differences in planting prescriptions.

Noxious Weed Eradication

Alternative 3 proposes non-chemical site preparation, release and noxious weed treatments using methods such as: burning, grazing, grubbing, hand-pulling, and native seeding. Because herbicides would not be used, some noxious weeds would continue to grow and flourish. Visitors' experience may be diminished if they are aware of weeds. Weeds can negatively affect a wide array of environmental attributes that are important to support recreation, including but not limited to soil quality, water quality and quantity, plant diversity, availability of forage and cover, and animal diversity and abundance (Eiswerth et al. 2005). Weeds and woody shrubs in some dispersed sites would limit the recreation area's availability. However, those visitors who oppose chemical treatments would be more likely to recreate in an area where this type of treatment would not occur. However, due to the increased effort involved in hand treatments, the presence of crews would be prolonged over the other action alternatives.

Reforestation

Alternative 3 would reforest the same amount of acres as Alternative 1, though the spacing and a different fuelbreak ridge treatment are different as discussed under 3.14 Visual Resources. In the long-term, visitors could be aware of large spaces used as fuelbreaks, but the majority of visitors would not be affected by the spacing. There could be additional shrub density in years 15-20, impeding cross-country foot travel, since herbicides would not be used, resulting in low tree survival rates and more opportunity for shrubs to colonize the area. Impacts to recreation would be the same as under Alternative 1, although there would be additional deep tilling in Alternative 3. The presence of crews and machinery would be more pronounced. Grubbing treatments would occur for several years, increasing the amount of workers in the field during that time over other alternatives. Visitors who did not want to encounter work crews or machinery could be displaced for longer periods under Alternative 3.

Prescribed Fire

Same as Alternative 1.

Thin Existing Plantations

The direct effect of Alternative 3 is that in some cases weeds would continue to grow and spread. People would not be exposed to herbicides under Alternative 3, but would continue to experience the effects of weeds and woody shrubs, such as noticeable changes to natural conditions and processes expected as part of a forest setting.

Cumulative Effects

Cumulative effects would be similar to Alternative 1, although visitors would see and hear additional and long-term evidence of workers in the project area due to the additional machinery and time needed for machine and hand treatments instead of herbicide applications.

Alternative 4

Direct and Indirect Effects

Herbicide Use and Noxious Weed Eradication

Alternative 4 includes similar noxious weed eradication and effects as Alternative 3, without the use of herbicides. However, herbicides would be used for release and planting activities. For those areas, impacts would be similar to Alternative 1, on a much smaller scale.

Reforestation

The main difference to recreation impacts under Alternative 4 would be less treatments proposed. There would be considerably fewer planted acres and trees than in Alternative 1. Reforestation would occur on only 20% of each unit proposed in Alternative 1. In addition, complex early seral forest is left intact and removed from reforestation consideration.

Effects would be similar to Alternative 1, but diminished in scope. Since far fewer acres proposed for treatment in Alternative 1 would not be treated under Alternative 4, the presence of crews, herbicide use, machinery, and burning would impact visitors in very few instances. Though some displacement could occur, recreation patterns would be expected to continue in a normal manner. However, impacts from lack of reforestation activities on the areas not treated would be similar to Alternative 2. Due to lack of reforestation, visitors could see a relatively open landscape in some areas, facilitating off trail travel, until brush development prohibited access, or until natural regeneration occurs.

Prescribed Fire

Much more burning would occur under this alternative; over 10 years, nearly 16,000 acres would be burned. Impacts would depend on rotation, location and size of each unit. If burn times are staggered, visitors would likely not be displaced or inconvenienced. If adjacent units are burned consecutively, visitors could be bothered by lingering smoke, delays, and the presence of fire crews. In some instances nearby roads and facilities could be temporarily closed during burn windows. The presence of active fire, while controlled, could cause some visitors anxiety and they could change their travel plans. Visitors with breathing challenges would tend to avoid the area entirely. Since units are fairly scattered through a large area, effects would be minor and short-term.

Thin Existing Plantations

Same as Alternative 1.

CUMULATIVE EFFECTS

Effects would be similar to, but considerably less than, Alternative 1 for the treated areas, and similar to Alternative 2 for those areas not treated. If a severe wildfire season that impeded recreation opportunities on a large part of the forest preceded the prescribed burning activities; the combination of the burning proposed in this alternative with the wildfire event would negatively affect recreation for that particular year.

Alternative 5

DIRECT AND INDIRECT EFFECTS

Herbicide Use and Noxious Weed Eradication

Same as Alternative 1.

Reforestation

Alternative 5 proposes planting conifers in the same areas proposed in Alternative 1, including the natural regeneration units, though some prescriptions are different. Impacts to recreation should not differ from Alternative 1. The spacing prescription is different than in the other action alternatives; instead of clumps or clusters, a more traditional approach is proposed. To some visitors, the even spacing may appear unnatural. Thinning of new plantations to create the ICO structure would make the stands appear more natural. The appearance is not expected to affect recreation patterns significantly. Cross country foot travel could be impeded by shrub cover in years 15-20; impacts would be similar to Alternative 1.

Prescribed Fire

Alternative 5 only includes prescribed fire in existing plantations. Effects from smoke would be less than the other action alternatives.

Thin Existing Plantations

Same as Alternative 1.

CUMULATIVE EFFECTS

Cumulative effects would be similar to Alternative 1.

Summary of Effects Analysis across All Alternatives

Alternatives 1, 3 and 5 would be similar. These include temporary negative effects of noise, dust and increased traffic on the recreation experiences of Forest users. The use of herbicides in Alternatives 1, 4 and 5 would cause temporary negative effects to visitors who are concerned about health issues associated with those treatments. Effects would include seasonal displacement, change in travel routes, or simple avoidance until after treatments are completed. Each action alternative proposes some form of weed treatment, which would ultimately benefit forest health, indirectly improving recreation in the area.

Alternative 4 would have much less impact on recreation from noise, dust and increased traffic, since considerably fewer acres are treated. Impacts of smoke would be greater and persist for more years under this alternative, and for short periods could cause more smoke-related displacement of visitors than the other alternatives.

3.09 Sensitive Plants

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

No federally listed plants occur on the Stanislaus National Forest. FSM 2670 and the Forest Plan provide direction for management of sensitive plants.

Sensitive Plants are defined as "those plant … species identified by a regional forester for which population viability is a concern, as evidenced by: a) significant current or predicted downward trends in population numbers or density and b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution" (FSM 2670.5). It is the Secretary of Agriculture's direction to "avoid actions which may cause a species to become threatened or endangered" (USDA 2008d). Further, it is a Forest Service objective to "maintain viable populations of all native ... plant species in habitats distributed throughout their geographic range on National Forest System lands" (FSM 2670.22). Forest Service policy set out in FSM 2670.32 is to "avoid or minimize impacts to [Sensitive] species whose viability has been identified as a concern." Where it is determined that impacts cannot be avoided, "the line officer with project approval authority, [may make] the decision to allow or disallow impact, but the decision must not result in loss of species viability or create significant trends toward federal listing."

Forest Plan direction for Sensitive Plants is to "provide for protection and habitat needs of sensitive plants, so that Forest activities will not jeopardize their continued existence." Forest Plan Standards and Guidelines advise to "modify planned projects to avoid or minimize adverse impacts to sensitive plants" (USDA 2010a, p. 60).

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

Assumptions Specific to Sensitive Plants

- The remaining 2% of the area that has not been surveyed for Sensitive Plants would be completed prior to implementation.
- Management requirements would be applied to the newly discovered populations.

Data Sources

- Rare plant occurrences, survey locations and habitats (GIS).
- RareFind 5 Database from the California Natural Diversity Data Base (CDFW 2014c), California Department of Fish and Wildlife (CDFW 2014d).
- Soil Survey, Stanislaus National Forest Area, California (USDA 1981).
- Tuolumne County Lithography.
- 2009 GIS Ortho Photo layers.
- Google Earth satellite aerial photos.
- Specimen herbarium records (CCH 2014).
- The paper-based Groveland Ranger District surveys completed atlas.

Sensitive Plant Indicators

- Sensitive Plant occurrences.
- Suitable habitat for sensitive plants and the condition of those habitats.
- Number of sensitive plants impacted by the project, the intensity of the impacts and the duration of the impacts.

Sensitive Plants Methodology by Action

A list of all federally listed Threatened, Endangered or Proposed plant species which might occur in the Stanislaus was acquired from the U.S. Fish and Wildlife Service (USFWS 2015).

A pre-field review was conducted to determine which sensitive plant species might occur or are known to occur within the project area (project record). Habitat attributes such as geology and soil types, elevation range, aspect and presence of closed canopy and forest openings were used to determine availability of suitable habitat for each species.

The effects of the Rim Reforestation project were analyzed using data from sensitive plant inventories, local observations of effects to the various plant species, anecdotal information for specific species documented in Regional Sensitive List revision forms and, where available, published research papers.

The project area will serve as the geographic bounds for effects analysis of sensitive plants. The project area is an appropriate size to assess the effects of the proposed activities because all potential disturbances and effects to sensitive plants would occur within this boundary. Any predictable effects to vegetation would remain within this area. For sensitive plants, the project area also serves as the area of analysis for cumulative effects because effects of other past, present, and foreseeable activities would interact with effects of the proposed project only within the project area.

The time frame considered for future effects is 10 years after implementation.

Affected Environment

Existing Habitat Conditions

The geology of the project area, as it relates to sensitive plant habitat, is quite varied. Bedrock and soil parent material are composed of granite, especially on the eastern half of the project, metasedimentary rock primarily on the western half of the project, or volcanically derived andesitic tuff (Mehrten Formation) which is isolated on some of the ridge tops and surrounding slopes. Soils in the project area are diverse, running the full range from deep sandy or loamy granitics to rocky clays of metasedimentary origin. The andesitic tuff breccia tends to be shallow, coarse and fast draining. This variety of soils and parent material allows for the establishment of rare plants, many of which have affinities for very specific types of soils or parent material. Lava caps were disturbed by the Rim Fire and some were also impacted during suppression activities. Before the fire, some of the lava caps were impacted by unauthorized motorized use causing localized disturbance.

Before the Rim Fire, plant communities within the project boundaries included Westside Ponderosa Pine Forest, Sierran Mixed Conifer Forest, several different chaparral communities such as Montane Manzanita Chaparral and Northern Mixed Chaparral, Montane Meadow, White Alder Riparian Forest, Aspen Riparian Forest, Blue Oak Woodland, and other oak woodland communities (Holland 1986). Among these were mixed conifer stands which had not burned in wildfires in more than 100 years and provided excellent habitat for occurrences of *Cypripedium montanum*, and small, low gradient perennial streams which provided excellent habitat for *Peltigera gowardii*. These high functioning ecosystems were relatively free of noxious weeds. Many of them burned with a moderate to high intensity in the Rim Fire where the conifer overstory was completely killed.

Wildfire has been an important component driving plant community composition within the analysis area during the past 100 years. Dating back as far as 1908, 124 wildfires occurred within the Rim Fire boundary (USDA 2010d). Some of the past fires overlapped with each other, burning some areas three, four or even five times prior to the Rim Fire. Other drivers of the pre-Rim Fire mix of plant communities include past logging, reforestation activities, cattle grazing and effective fire suppression.

Many of the Westside Ponderosa Pine Forest areas were conifer plantations 10 to 40 years of age. Some of the plantations were isolated and the result of old clear-cut timber harvests. However, most of the plantations were planted as part of the recovery from the1973 Granite Fire, the 1987 Stanislaus Complex fires and the 1996 Ackerson Complex or Rogge Complex fires. The Wrights Creek plantations dated from the 1950s and the Sawmill plantations dated from the 1960s and were also the result of post-fire recovery. The past wildfires and subsequent salvage logging and reforestation activities created thousands of acres of disturbed habitat. These plantations were in various phases of growth and many had been thinned in the past 15 years. Due to their mostly early seral nature, the understories had low native plant diversity and were primarily composed of disturbance followers such as non-native annual grasses and native shrubs like deerbrush (*Ceanothus integerrimus*), manzanita (*Arctostaphylos* sp.), bearclover (*Chamaebatia foliolosa*) and Sierra gooseberry (*Ribes roezlii*).

Sensitive Species

As described in the Sensitive Plant BE and Botany Report, rarity in plants can be the result of a number of things. Loss of habitat is a key factor for some species. Reproductive isolation through loss of populations is another factor. In many cases, the scarcity of the habitat in which the species evolved is the limiting factor which makes the species rare. Many of the sensitive plants considered in the Rim Reforestation project are limited to specialized or scarce habitats such as cliffs, vernal pools, fens (spring-fed seep or meadow areas containing 16 inches or more of peat), or “lava caps” (prehistoric volcanic ash mud flows also known as lahars and composed of andesitic tuff).

Within the Rim Reforestation project, the majority of the treatment units have been surveyed for all sensitive species based on the unit’s habitat attributes and the current Sensitive Plant List. Approximately 2% of the project area remains unsurveyed.

The following Sensitive Plant species are known to occur within the project area: *Balsamorhiza macrolepis, Clarkia australis, Clarkia biloba* ssp. *australis, Cypripedium montanum, Erythronium taylori, Mimulus filicaulis, Mimulus pulchellus,* and *Peltigera gowardii.*

In addition, suitable habitat within the appropriate geographic and elevational ranges exists within the project area for the following species: *Allium tribracteatum, Allium yosemitense, Arctostaphylos nissenana, Botrychium ascendens, Botrychium crenulatum, Botrychium lineare, Botrychium lunaria, Botrychium minganense, Botrychium montanum, Botrychium pedunculosum, Botrychium pinnatum, Bruchia bolanderi, Cinna bolanderi, Dendrocollybia racemosa, Eriastrum tracyi, Eriogonum luteolum var. saltuarium, Eriophyllum congdonii, Eriophyllum nubigenum, Erythronium tuolumnense, Fissidens aphelotaxifolius, Helodium blandowii, Horkelia parryi, Hulsea brevifolia, Lewisia kelloggii* ssp. *hutchisonii, Lewisia kelloggii* ssp. *kelloggii, Lomatium stebbinsii, Meesia uliginosa, Mielichhoferia elongata, Mielichhoferia shevockii* and *Tauschia howellii.*

The following plant profiles are for species which are known from the project area.

Balsamorhiza macrolepis (big-scale balsamroot) is a perennial herb in the sunflower family, Asteraceae. It reproduces by seed. *Balsamorhiza macrolepis* begins growing in late winter or early spring and blooms in mid-spring. The plant goes dormant during the summer, after seeds are produced. The range of *Balsamorhiza macrolepis* is the Sierra Nevada Foothills from Tehama County south to Mariposa County, and the interior Coast Range from Tehama County (Mendocino National Forest) south to Santa Clara County. *Balsamorhiza macrolepis* inhabits a variety of soil and plant community habitats. It has been reported from ponderosa pine forest, chaparral, vernally moist meadows and grasslands or grassland within oak woodland. Most of the occurrences are found in serpentine substrates, but it is also known to grow in soils derived from sandstone, basalt, and rocky clays of metasedimentary origin. The known occurrences in the Rim Fire burned area and the Yosemite occurrence are on granitic soils. *Balsamorhiza macrolepis* is usually found in openings or under an open brush cover. The elevation range is listed as below 4,600 feet (Jepson Flora Project 2014). It occurs as high as 4,700 feet elevation in the Stanislaus.

Clarkia australis (Small's southern clarkia) is an annual herb which grows in openings in ponderosa pine and mixed-conifer stands often in association with bearclover. *Clarkia australis* prefers sites with little or no competition from aggressive weedy species. When not associated with bearclover, the species is usually observed growing in bare mineral soil or with a very light layer of leaf litter. *Clarkia australis* has a very narrow range in Tuolumne and northern Mariposa Counties. The Rim Fire burned through a large portion of the known occurrences of this species.

Clarkia biloba ssp. *australis* is an annual herb which usually grows under light shade in oak woodland, chaparral and conifer forests. Like *Clarkia australis*, it prefers to grow where there is little competition from weedy species.

Cypripedium montanum (mountain ladyslipper orchid) is a perennial herb in the orchid family, Orchidaceae. It arises in early spring from shallow rhizomes and dies back by late summer. The appropriate identification period for this species is mid-spring, approximately early May to mid or late June. In the Stanislaus, *Cypripedium montanum* inhabits sites which are relatively undisturbed with a moderate to dense overstory, usually containing Douglas-fir or white fir. These sites are typically west or north-facing with fairly damp, deep loamy soils and a welldeveloped duff layer. In the Stanislaus, *Cypripedium montanum* ranges in elevation from 3,500 to 6,500 feet. The elevation range for California is listed as 650 to 7200 feet (Jepson Flora Project 2014).

Erythronium taylori (Taylor's fawn lily) is a perennial herb in the lily family, Liliaceae. It was discovered by Dean Taylor, Ph.D. in 1996 in the Groveland Ranger District and described by James R. Shevock and Geraldine A. Allen (1997). It emerges from a corm in early spring and withers by mid-June. The appropriate identification period for this species is early spring, approximately the month of April. *Erythronium taylori* is found in habitat that is shaded, northfacing cliffs. Because other species of *Erythronium* can inhabit a variety of north-facing habitats, it's possible that *Erythronium taylori* might occur on sites, which are not cliff-like. The elevation is approximately 4,200 feet.

Mimulus filicaulis (the slender-stemmed or Hetch-Hetchy monkey flower) and *Mimulus pulchellus* (the pansy monkey flower) are annual herbs which occur in seasonally damp soils, seeps, springs, meadows and drainages in openings in forests or chaparral. *Mimulus pulchellus* is often found growing in “lava cap” soils. *Mimulus filicaulis* has a very narrow range from the Tuolumne River south to Mariposa County. Most of the occurrences are centered on the area east of Cherry Lake Road and north of Highway 120 and west of the boundary with Yosemite National Park. The range of *Mimulus pulchellus* is Calaveras, Tuolumne and Mariposa Counties. Both *Mimulus filicaulis* and *Mimulus pulchellus* prefer to grow in areas with little competition. Both tolerate low levels of soil disturbance, such as caused by gophers after the plants have gone to seed.

Peltigera gowardii (Goward’s waterfan) is a lichen which grows submerged or within spray zones of perennial streams. The streams are shallow and often fed by cold water springs. The water is very clear and peak flows are not of the intensity that would lead to scouring. The range of this species is from southern Alaska to Fresno County in California.

In addition to Sensitive Plants, the Botany Report analyzed Forest Watchlist and Botanical Interest species. Forest Watchlist species include those which are locally rare (as opposed to declining throughout their range), are of public concern, occur as disjunct populations, are newly described taxa, or lack sufficient information on population size, threats, trend, or distribution. Botanical interest species are those which are protected or enhanced for the purpose of conserving botanical richness or diversity within the National Forest. These are typically species which are uncommon in the Forest, but not necessarily uncommon at a regional or global scale. They are sometimes species at the extent of their geographic ranges, disjunct from areas where they are common, or are limited by habitats which are uncommon in the Forest, but more numerous elsewhere.

Environmental Consequences

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Sensitive Plant occurrences will be avoided during implementation. Additionally, sun-loving species of sensitive plants would be provided with a buffer to remove the indirect effects of shading from replanting. No occurrences are expected to be eliminated as a result of these situations. Table 3.09-1 shows the number of known occurrences and their acreage overlapping proposed treatments.

Table 3.09-1 Alternatives 1, 3 and 5: Sensitive Plant Occurrences Overlapping Treatment Areas

Sensitive Plant Species	Occurrences in units (number)	Occurrences in units (acres)
Balsamorhiza macrolepis	4	0.21
Clarkia australis	170	154.85
Clarkia biloba ssp. *australis*	45	105.11
Cypripedium montanum	21	3.08
Erythronium taylori	1	11.53
Mimulus filicaulis	88	66.93
Mimulus pulchellus	15	27
Peltigera gowardii	6	7.41

With avoidance of most sensitive plant occurrences, only *Clarkia australis*, *Clarkia biloba* ssp. *australis*, *Mimulus filicaulis* and *Mimulus pulchellus* would possibly be directly affected by the proposed activities. In some of these occurrences, manual site preparation would be allowed during the dry non-growing period when the species are present as seed, not living plants. Conducting manual site preparation within these occurrences poses a low to moderate risk of damage or death of some of the seeds even when implemented during the dry, non-growing period. The risk would come from trampling by workers. The amount of seed damaged or lost is expected to be minimal.

Effects to *Clarkia australis* are reduced by not allowing equipment to track through occurrences smaller than 0.25 acre and to minimize tracking through occurrences larger than 0.25 acre. Rather than impacting growing plants, activities in *Clarkia australis* occurrences would be restricted to the dry, non-growing period, when they would have less impact by allowing annual seed set and conserving seed in the soil. These standard management requirements greatly reduce the risk that occurrences of *Clarkia australis* would be eliminated. The benefit of conducting mastication within occurrences of *Clarkia australis* is the reduction of fuels (trees and brush) and inter-tree competition which would contribute to fuel loading and thereby lower the risk of losing occurrences during the next wildfire. Additionally, mastication might help prevent or diminish the establishment of dense brush which might otherwise dramatically reduce the quality of the habitat for Clarkia which prefers to grow in forest openings with little or no competition. The benefit of subsoiling in *Clarkia australis* occurrences is the enhancement of habitat.

Conducting manual site preparation within occurrences of *Clarkia australis*, *Clarkia biloba* ssp. *australis*, *Mimulus filicaulis* or *Mimulus pulchellus* poses a low to moderate risk of damage or death of some of the seeds even when implemented during the dry, non-growing period. The risk would come from trampling by workers. The amount of seed damaged or lost is expected to be minimal.

Table 3.09-2 details the number of occurrences affected by manual treatment. The acres presented are the amount of treatment that intersects with sensitive plant occurrences rather than the acres of sensitive plants affected. As a result, the number of acres for each species is likely inflated. Most of the percentages are low with *Clarkia biloba* ssp. *australis* being the most affected with 53% of the occurrences impacted, but only 5% of the total acreage. *Clarkia australis* is moderately affected in terms of occurrences affected (17%), but only has 7% of the total acreage in the project area affected. *Mimulus fillicaulis* has a negligible amount affected while M*imulus pulchellus* is not affected by hand treatments.

Table 3.09-2 Alternative 1: Occurrences Intersecting Manual Treatments

Sensitive Plant Species	**Number of Occurrences in units** (percent of total)	**Acres of Occurrences in units** (percent of total)
Clarkia australis	29 (17%)	11.3 (7%)
Clarkia biloba ssp. australis	24 (53%)	5.3 (5%)
Mimulus filicaulis	2 (2%)	0.24 (less than1%)
Mimulus pulchellus	0	0

The Sensitive aquatic lichen *Peltigera gowardii* may be affected indirectly by project activities. It is expected that activities which change these habitat characteristics – increase sedimentation, scour or sun exposure – would likely lead to a reduction or loss of individuals, and depending on the degree of impact, perhaps loss of the occurrence. Sedimentation or scouring could damage the thin, gelatinous thallus of *Peltigera gowardii* by abrading it, leading to death of the organisms (USDA 2010c). Sedimentation could also cover the organisms, blocking their ability to photosynthesize (USDA 2010c). The soil and watershed BMPs would prevent direct impacts to the species, and would reduce the amount of activity-created sediment in these occurrences. Planting trees will have the long-term benefit of producing shade by returning the canopy back to previous conditions.

Noxious weed eradication has the potential to indirectly affect rare plant species through accidental spills, spray drift, surface runoff, or a combination of these factors. These potential effects would be greatly limited by implementing BMPs and management requirements. Noxious weed invasion can result in negative impacts to all habitat types, although different habitats may be invaded by different suites of noxious weed species. Noxious weed infestations can lead to changes in habitat characteristics that are detrimental to sensitive plant species. Once weeds have become established they can indirectly impact sensitive species through allelopathy (the production and release of chemical compounds that inhibit the growth of other plants), altering fire regimes, and competing for nutrients, light, and water. Treatment of known noxious weed sites reduces the risk of the impacts, while also potentially opening up suitable habitat for colonization for sensitive plant populations near infested areas.

Thinning existing plantations to an ICO structure would likely benefit species found within thinning units, *Balsamorhiza macrolepis*, *Clarkia australis, Clarkia biloba* ssp. *australis, Mimulus filicaulis* and *Mimulus pulchellus*, if the occurrences are in close proximity to open patches to potentially colonize. One occurrence of *Cypripedium montanum* has less than 0.01 acre within thinning units. This species would benefit by maintaining clumps on its edge.

CUMULATIVE EFFECTS

Present and future projects planned within the Rim Reforestation project area (Appendix B) incorporate management requirements which reduce the risk of loss of occurrences. The combined effects of the proposed activities in Alternative 1 with other present and foreseeable future actions, shown in Table 3.09-3, are not expected to result in adverse cumulative effects to sensitive plants, mainly due to flagging and avoiding known sites. Individuals may be adversely affected by proposed project activities. However, these impacts are not expected to be so great in intensity or duration that any of these occurrences would be eliminated, even when combined with other Forest activities.

Table 3.09-3 Alternatives 1, 3, 4 and 5: Sensitive Plants Overlapping Cumulative Effects Activities

Sensitive Plant Species	Project Activity Type	ALT 1 (acres)	ALT 3 (acres)	ALT 4 (acres)	ALT 5 (acres)
Balsamorhiza macrolepis	Grazing	0.21	0.21	0.09	0.21
Balsamorhiza macrolepis	Rim HT: MP	0.09	0.09	0.09	0.09
Balsamorhiza macrolepis	Rim Recovery: HP, MP, JP, Burn	0.10	0.10	0	0.10
Clarkia australis	Grazing	154.85	154.85	72.58	154.85
Clarkia australis	Rim HT: MP	16.12	16.12	8.50	16.12
Clarkia australis	Rim Recovery: HP, MP, JP, Burn	84.23	84.23	66.22	84.23
Clarkia australis	Wildlife Habitat Enhancement: Encroaching conifers	0.15	0.15	0.15	0.15
Clarkia biloba ssp. *australis*	Grazing	105.11	105.11	0.76	105.11
Clarkia biloba ssp. *australis*	Rim HT: MP	50.92	50.92	0.45	50.92
Clarkia biloba ssp. *australis*	Rim Recovery: HP, MP, JP, Burn	21.00	21.00	0.30	21.00
Cypripedium montanum	Grazing	3.08	3.08	1.48	3.08
Cypripedium montanum	Rim HT: MP	0.47	0.47	0.47	0.47
Cypripedium montanum	Rim Recovery: HP, MP, JP, Burn	1.21	1.21	0.96	1.21
Cypripedium montanum	Rim Rehabilitation: Great Gray Owl: Ackerson	0.30	0.30	0	0.30
Erythronium taylori	Grazing	11.53	11.53	11.53	11.53
Erythronium taylori	Rim Recovery: LS, JP, Burn	11.53	11.53	11.53	11.53
Mimulus filicaulis	Grazing	66.93	66.93	2.26	66.93
Mimulus filicaulis	Rim HT: MP	9.13	9.13	0.64	9.13
Mimulus filicaulis	Rim Recovery: HP, MP, JP, Burn	10.39	10.39	1.29	10.39
Mimulus filicaulis	Rim Rehabilitation: Meadow-Stream/meadow North Sawmill	0.33	0.33	0	0.33
Mimulus filicaulis	Soldier Timber Sale	0.20	0.20	0	0.20
Mimulus pulchellus	Grazing	27.00	27.00	1.22	27.00
Mimulus pulchellus	Rim HT: MP	1.07	1.07	0	1.07
Mimulus pulchellus	Rim Recovery: HP, MP, JP, Burn	16.08	16.08	1.22	16.08
Mimulus pulchellus	Wildlife Enhancement: Meadow handwork Lower Femmons	0.08	3.64	0.72	3.64
Peltigera gowardii	Grazing	7.41	7.41	5.17	7.41
Peltigera gowardii	Rim HT: MP	3.48	3.48	3.28	3.48
Peltigera gowardii	Rim Recovery: HP, MP, JP, Burn	3.08	3.08	1.67	3.08
Peltigera gowardii	Rim Recovery: LS, JP, Burn	0.10	0.10	0.10	0.10

ALT=Alternative; HC=Hand Cut; HP=Hand Pile; JP=Jackpot Burn; LS=Lop and Scatter; MP=Machine Pile (with dozer)

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

Alternative 2 has no direct effects to Sensitive Plants. Indirect effects could occur from increased invasion of existing noxious weed populations, potential increase in the risk of future high severity wildfire due to not removing standing biomass and woody fuels. In some cases dense brush is likely to take over some habitat, overtopping rare plant species and effectively shading them out of former habitat. The potential benefits to annual species and *Balsamorhiza macrolepis* would not be realized as existing plantations would not be thinned and denser canopies over a larger area would be maintained.

CUMULATIVE EFFECTS

Projects that occur within the cumulative effects area (such as Rim Recovery and Rim HT) utilized flag and avoid to minimize effects to sensitive species. As a result, these actions are not expected to contribute to adverse cumulative effects. *Peltigera gowardii* occurrences are at a high risk of loss to sedimentation in Alternative 2 since no reforestation activities would contribute to soil stabilization to prevent sedimentation.

Alternative 3

Direct and Indirect Effects

Table 3.09-1 shows the number of occurrences potentially affected in Alternative 3 are the same as Alternative 1; however, two of those occurrences of *Clarkia australis* could be affected by subsoiling. Alternative 3 also proposes 2,565 fewer acres of noxious weed treatments than Alternative 1, while also proposing the opening of more bare mineral soil through hand grubbing. Additionally, weed treatment does not include herbicides, which would make the treatments less effective and noxious weeds would persist at sites within the project longer. The risk of noxious weed invasion is high in Alternative 3 compared to moderate in Alternative 1. The potential effects to Sensitive plants are also comparatively higher.

Cumulative Effects

Same as Alternative 1 (Table 3.09-3).

Alternative 4

Direct and Indirect Effects

The direct and indirect effects of this alternative would be similar to those described in Alternative 1. However, as Table 3.09-4 shows, Alternative 4 has the least treatment acres, so less occurrences of most of the species would be affected. A greater percentage of occurrences fall within hand treatments in Alternative 4 compared to Alternative 1 and Alternative 4 would create more ground disturbance through prescribed burning than the rest of the action alternatives.

Alternative 4 has a greater risk of weed spread since no herbicides are proposed for use in weed eradication and fewer weed populations and species would be targeted. Therefore, even though this alternative proposes treatment in fewer rare plant occurrences the overall risk of noxious weed invasion into these areas is greater.

Table 3.09-4 Alternative 4: Sensitive Plants Overlapping Proposed Reforestation Activities

Sensitive Plant Species	Occurrences in units (number)	Occurrences in units (acres)
Balsamorhiza macrolepis	1	0.09
Clarkia australis	62	75.28
Clarkia biloba ssp. *australis*	5	0.76
Cypripedium montanum	10	1.48
Erythronium taylori	1	11.53
Mimulus filicaulis	12	2.26
Mimulus pulchellus	2	1.22
Peltigera gowardii	2	5.17

Cumulative Effects

Table 3.09-3 shows fewer occurrences would be cumulatively affected in Alternative 4 as compared to Alternative 1. The effects are expected to be similar to those described in Alternative 1, but the magnitude of the effects would be smaller since less occurrences of annual species would potentially be treated.

Alternative 5

Direct and Indirect Effects

Same as Alternative 1 (Table 3.09-1).

CUMULATIVE EFFECTS

Same as Alternative 1 (Table 3.09-3).

Summary of Effects Analysis across All Alternatives

For all action alternatives, the Rim Reforestation project will not impact *Allium tribracteatum, Allium yosemitense, Arctostaphylos nissenana, Eriastrum tracyi, Helodium blandowii, Meesia uliginosa, Mielichhoferia elongata,* and *Mielichhoferia shevockii* because activities are not proposed in their habitats.

For all action alternatives, the Rim Reforestation project may affect individuals, but are not likely to result in a trend toward federal listing or loss of species viability for *Balsamorhiza macrolepis, Botrychium ascendens, Botrychium crenulatum, Botrychium lineare, Botrychium lunaria, Botrychium minganense, Botrychium montanum, Botrychium pedunculosum, Botrychium pinnatum, Bruchia bolanderi, Cinna bolanderi, Cypripedium montanum, Dendrocollybia racemose, Eriogonum luteolum* var. *saltuarium, Eriophyllum congdonii, Eriophyllum nubigenum, Erythronium taylori, Erythronium tuolumnense, Fissidens aphelotaxifolius, Horkelia parryi, Hulsea brevifolia, Lewisia kelloggii* ssp. *hutchisonii, Lewisia kelloggii* ssp. *kelloggii, Lomatium stebbinsii, Peltigera gowardii.*and *Tauschia howellii* because even though flagging and avoiding will be in place or known locations do not exist, some undiscovered populations may be affected within suitable habitat that will be treated.

For *Clarkia australis*, *Clarkia biloba* ssp. *australis*, *Mimulus filicaulis,* and *Mimulus pulchellus,* all action alternatives of the Rim Reforestation project may affect individuals, but are not likely to result in a trend toward federal listing or loss of species viability because portions of their occurrences would likely receive adverse effects, but populations are not expected to be eliminated within the project area.

Even though the no action alternative does not manage for the increased risk of weed spread in the project area the effects to sensitive plants is minor because no disturbance activities would be implemented. The consequences are that it may affect individuals, but is not likely to result in a trend toward federal listing or loss of species viability for all sensitive species with suitable habitat in the project area.

The comparison of effects between alternatives concentrates on three main factors. The first factor is the amount of annual species (*Clarkia australis*, *Clarkia biloba* ssp. *australis*, *Mimulus filicaulis,* and *Mimulus pulchellus)* affected by treatments. This impact corresponds to the Sensitive Plant indicators: Sensitive Plant occurrences; and number of sensitive plants impacted by the project, the intensity of the impacts and the duration of the impacts. The second factor is the risk of weed spread inherent in each alternative. This impact corresponds to the Sensitive Plant indicators: suitable habitat for sensitive plants and the condition of those habitats; and the number of sensitive plants impacted by the project, the intensity of the impacts and the duration of the impacts. The third factor is the amount of habitat rehabilitated to pre-fire conditions. This impact corresponds to the Sensitive Plant indicator: suitable habitat for sensitive plants and the condition of those habitats.

Table 3.09-5 presents the comparison of effects between alternatives by assigning a value of 1 through five for each impact factor. A one indicates the lowest level of impact while a five indicates the highest level of impact. In the case of identical effects, each alternative was given the same value while the next highest impact was given the next available value. For example, for the amount of habitat restored to pre-fire conditions impact, alternatives 1, 3 and 5 were given a value of 1 while the next alternative was given a value of 4. All four of the impacts were weighted equally.

This comparison of impacts between alternatives indicates that Alternative 1 and 5 have the least impact followed by Alternatives 3, 4 and 2 in order of higher impact.

Table 3.09-5 Comparison of Alternatives: Impacts to Sensitive Plants

Impact Factor	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3	Alternative 4	Alternative 5
Amount of annual species affected	5	1	5	2	5
Risk of noxious weed spread	1	5	3	4	1
Amount of habitat restored to pre-fire conditions	1	5	1	4	1
Aggregate impact score	7	11	9	10	7

3.10 Society, Culture and Economy

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

Multiple statutes, regulations and executive orders identify the general requirement for the application of economic and social evaluation in support of Forest Service planning and decision making. These include, but are not limited to, the Multiple-Use Sustained Yield Act of 1960 (74 Stat. 215: 16 USC 528-531), National Environmental Policy Act of 1969 (83 Stat. 852; 42 USC 4321, 4331-4335, 4341-4347), and the Planning Act of 1974. In addition, the following guidance also applies.

Executive Order 12898 issued in 1994 orders federal agencies to identify and address any adverse human health and environmental effects of agency programs that disproportionately impact minority and low-income populations. The Order also directs agencies to consider patterns of subsistence hunting and fishing when an agency action may affect fish or wildlife.

The Civil Rights Act of 1964 provides for nondiscrimination in voting, public accommodations, public facilities, public education, federally assisted programs, and equal employment opportunity. Title VI of the Act, Nondiscrimination in Federally Assisted Programs, as amended (42 U.S.C. 2000d through 2000d-6) prohibits discrimination based on race, color, or national origin.

Office of Management and Budget Circular A-94 "Guidelines and Discount Rates for Benefit-Cost analysis of Federal Programs," (Revised October 29, 1992), and including Appendix C Revised December 2014 presents discount rates to be used for economic analyses conducted in calendar year 2015. This circular provides guidelines for evaluating the economic efficiency of Federal agency programs and projects that take place over a number of years.

The Forest Plan Compliance (project record) document identifies the Forest Plan S&Gs that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

Assumptions Specific to Society, Culture and Economy

- The majority of the Rim Fire burned within Tuolumne County, but the southern portion of the fire also burned into Mariposa County. The primary socioeconomic impacts would occur within a geographic region of impact defined by these two counties. Some secondary impacts would be felt in other counties as noted in the analysis below.
- The Environmental Justice analysis reports what effects might occur to minority and low-income populations. Of particular concern is whether job or income discrimination might occur to these groups in the area during, or resulting from, the proposed project.

Data Sources

- California Department of Finance
- California Employment Development Department
- IMPLAN Group, LLC
- United States Census Bureau
- USDA Forest Service

Society, Culture and Economy Indicators

Indicators used in the analysis of economic and social effects may be grouped into three categories as directed by Forest Service Manual (FSM) Chapter 1970 - "Economic and Social Evaluation." The three categories are:

- Economic Efficiency
- Economic Impact

- Social Analysis

ECONOMIC EFFICIENCY

Undertaking the proposed actions, a long-term investment, would have immediate costs during implementation over the next 10 to 15 years, but the value in forest products will not be fully realized until trees mature 60 years or more in the future. As directed by FSM and Forest Service Handbook 1909.17, the primary indicators of economic efficiency in this type of long-term situation should be:

- Present Net Cost (PNC)
- Present Net Benefit (PNB)
- Present Net Value (PNV)

Estimates are made for these indicators in order to make comparisons between alternatives, and not to attempt to measure absolute numbers for outputs. Also, no attempt has been made to assign monetary values to resource outputs such as wildlife, watershed, soils, or fisheries.

ECONOMIC IMPACT

Within the two-county region of impact, jobs were selected as the single best indicator of economic health because jobs are intuitively understandable and easily observed by the communities affected, but it should be noted that beneficial or adverse economic impacts on jobs are highly correlated with such other measures of economic health as gross regional product, economic output, personal income, and the portion of gross regional product that ultimately finds its way into local and state taxes. The key indicators are:

- Employment information at the county level for context
- Jobs supported by Rim Reforestation project activities

SOCIAL ANALYSIS

Non-market values, such as the value of recreation experiences or stability in rural lifestyles, by their nature are difficult to quantify. Direction provided in 40 CFR 1502.23 and Forest Service Handbook 1909.15, (7/6/04) and 22.35 (01/14/05) provides for the use of qualitative analysis to evaluate the effects of these non-market values. The non-market aspects of each proposed activity will be described in other resource sections and specialist reports. Key indicators include:

- Local population trends and community demographic statistics
- Recreation patterns within the region of impact (qualitative)
- Potential for differential impacts on low income, minority, and other disadvantaged population groups (qualitative)
- Social/cultural impacts to American Indians, ranching, regional business owners and summer camps (qualitative)

Society, Culture and Economy Methodology by Action

Actions, or the lack thereof, would have an effect on the society, culture and economy of Tuolumne and Mariposa Counties. Although not all of the socio-economic effects can be quantified, the methodology at least describes the mechanisms through which effects may be felt and characterizes their relative magnitude and direction (i.e., beneficial or adverse). Actions through which socio-economic effects may be generated can be clustered into activity groups and include:

- **Reforestation**, the activity group with the highest costs to the government and highest economic impact, includes a more detailed sequence of possible activities including: site preparation, planting of conifers, release, and prescribed fire.
- **Noxious Weed Eradication**, which includes such weed removal methods as burning, grazing, grubbing, herbicides and hand pulling.
- **Deer Habitat Enhancement**, which is essentially a special type of reforestation designed to benefit the deer population and includes the same detailed sequence of possible activities.

- **Natural Regeneration**, where initial activities are limited to fuels reduction. If after five years natural regeneration is not adequate, more traditional reforestation activities may be applied.
- **Thin for ICO Structure within Existing Plantations**, where the activities are designed to remove selected trees and understory through such methods as mechanical harvesting, hand cutting, mastication, and prescribed burns.

METHODOLOGY FOR ASSESSING ECONOMIC EFFICIENCY

Most of the actions would require the government to incur near-term costs to implement them. Some of the actions would create the potential for the government to receive revenue over the long-term through sales of timber and other forest products. Some of the actions would also create environmental benefits such as enhanced habitat for deer and other animals, or reduction of noxious weeds and other invasive species, which are noted as beneficial or adverse, but are not quantified in dollar terms for purposes of assessing the differences in economic efficiency between alternatives.

The near term costs to the government will be estimated by applying per-acre costs based on recent experience of the Stanislaus NF for paying qualified contractors to perform similar actions to the number of acres to be treated according to each alternative, with costs spread out over the next few years as implementation proceeds. Per-acre cost estimates of actions expressed in 2015 dollars are presented in Table 3.10-1. Most of the expenditures of public funds would go to private contractors to perform the bulk of the work, but the Forest Service would conduct all burning actions and the survival exam surveys and certifications.

Table 3.10-1 Average Estimated Cost of Treatment Actions per Acre

Treatment Action	Contract Cost per Acre	Agency Workforce Cost per Acre
Deep till and forest cultivate	$450	$0
Feller buncher	$450	$0
Mastication	$650	$0
Hand cut	$750	$0
Machine pile and burn	$430	$200
Hand pile	$400	$0
Burn piles	$0	$200
Jackpot burn	$0	$650
Hand herbicide application (site preparation and release)	$450	$0
Plant 7 feet x 14 feet	$350	$0
Plant ICO Structure	$425	$0
Survival exams (1st, 3rd and 5th year)	$0	$100
Release by hand grubbing, once during the year	$800	$0
Release by hand grubbing, two times during the same year	$1,600	$0
Agency costs for monitoring Natural Regeneration units	$0	$100
Prescribed fire - low complexity (plantations/treated areas)	$0	$650
Prescribed fire - high complexity (complex early seral)	$0	$1,000
Burning through aerial ignition	$0	$1,000

Source: Stanislaus National Forest recent historical contracting.

For each alternative with its unique mix of treatments to be conducted on a number of acres, the Present Net Cost (PNC) is estimated by multiplying by the cost factors above to acres treated each year, and then by discounting near-term future costs using guidance from OMB Circular A-94 which specifies rates to be used for economic analysis of federal decisions considered in calendar year 2015. The near-term discount rates are presented in Table 3.10-2 for analyses conducted in real dollars (i.e., where the effects of future inflation have been taken out by using constant 2015 dollars). The discount rates shown are those specified in Appendix C of OMB Circular A-94, and as directed by the instructions, discount rates for the intervening years may be estimated through linear interpolation. Federal actions with durations longer than 30 years may use the 30-year interest rate.

Table 3.10-2 Real Discount Rates to be Used in Federal Decisions Considered in 2015

Item	Year 3	Year 5	Year 7	Year 10	Year 20	Year 30
Discount Rate	0.1%	0.4%	0.7%	0.9%	1.2%	1.4%

Source: OMB Circular A-94, Appendix C (Revised December 2014)

The Present Net Benefit (PNB) of each alternative is estimated by multiplying the possible revenue the government could generate decades into the future through thinning of trees, and ultimately through green timber sales once forests have matured sufficiently to yield sustainable harvests of timber. These distant future positive values also are discounted back to the present, and OMB Circular A-94 specifies an annual discount rate of 1.4% for cash flows that occur 30 or more years into the future. For example, the value of \$100 earned through timber sales that take place 60 years from now, would only be worth \$43 today:

$$\text{PNB} = \$100 \times \frac{1}{(1 + 1.4\%)^{60}}$$

$$\text{PNB} = \$100 \times 43\%$$

$$\text{PNB} = \$43$$

Estimating the value of green timber harvested far into the future clearly requires speculation. To remove the influences of possible future inflation, current values can be used, but even those fluctuate dramatically. For example, in the local market due in part to the large volume of salvaged trees recently available from the Rim Fire, and due in part to the national recession the U.S. building industry is only now recovering from, the demand for saw logs is currently at a historic low in Tuolumne County. From a much larger perspective, looking at the value of timber sold Forest Service wide over the last 30 years as reported to Congress, values have ranged from as low as \$50 to over \$170 per thousand board feet (MBF). The average revenue to the government has been approximately \$100 per MBF, and this statistic will be used as a reasonable estimate of future timber sales potential as measured in today's dollars. Again, future sales will be discounted depending on how far in the future they are expected to take place to reach the Present Net Benefit to the government. The single best estimate of the economic efficiency of an alternative is the PNV, which is the sum of PNC and PNB.

METHODOLOGY FOR ESTIMATING ECONOMIC IMPACT

Paying contractors to perform treatments in Rim Fire units would create temporary direct employment in Tuolumne and Mariposa counties. Although many of the laborers and skilled equipment operators directly employed are likely to be residents of other counties, or even other states, drawn to the Stanislaus to perform temporary jobs, the expenditures of contractors and their employees while in Tuolumne and Mariposa counties would also generate some modest indirect and induced employment through multiplier effects in the two-county region of impact.

The estimate of direct employment generated in each year is based on the total budget to be spent on contractors in that year across all units and all activities. Approximately half of the total budget is expected to go to the labor providing the work in the forest, with the other half including such uses as costs of equipment and supplies, transportation, payroll taxes, insurance, contractor overhead and profit and a small portion to Forest Service overhead costs of administering the contracts. Employment generation, measured in full-time-equivalent jobs is estimated by dividing labor costs by a mean annual wage of \$44,000, corresponding to a mean hourly wage of \$21.15. The mean hourly wage is derived from the Occupational Employment Statistics and Wages (OES) survey conducted by the California Employment Development Department (EDD) for the "Mother Lode Region," which includes the counties of Amador, Calaveras, Mariposa and Tuolumne. In the most recent OES data, released July 2015, the mean hourly wage for Farming, Fishing, and Forestry Occupations was $16.36, but half of those workers were relatively low-paid farm laborers (earning a mean of $10.84 per hour). Logging Equipment Operators in the Mother Lode Region are earning a mean of $20.81 per hour, First-Line Forestry Supervisors $23.73 and Fallers $29.35 on average. EDD uses 2,080 hours per year to estimate mean annual wages for someone employed full time, and thus a $21.15 hourly wage would create a full-time-equivalent wage income of $44,000 for the worker.

Additional jobs would be indirectly supported in the region of economic impact as a result of the activities described above. Economic models based on input-output analysis are used to generate "multipliers" which estimate the "indirect" and "induced" economic effects associated with "direct" impacts. For example, if the operator of a feller buncher is the direct job supported, an indirect job would be held by the mechanic in Tuolumne County that services the equipment. Part of an induced job is supported in the local grocery store where both of the previous employees shop after work. In the methodology used for alternatives analysis, multipliers are derived from the IMPLAN system, developed by the Minnesota IMPLAN Group, Inc. (MIG) and now being vended by IMPLAN Group, LLC. Multipliers are lower for small economic areas than they are for the state as a whole, and the relevant multipliers for the direct industries affected average 1.5, indicating that for every job directly generated by the treatment activities, another half a full-time-equivalent job would be supported in Tuolumne or Mariposa Counties through indirect or induced mechanisms. Again, the goal is to create employment indicators that may be evaluated consistently across all alternatives, and not necessarily to estimate absolute numbers of jobs created in any given year. Also note that because annual average wages and full-time-equivalent statistics are used in the estimates, many more people would likely experience some additional employment than is indicated, because most of the direct jobs in the forest and the indirect and induced jobs in the service industries of Tuolumne and Mariposa counties are part-time in nature.

METHODOLOGY FOR ANALYZING SOCIAL ANALYSIS

Social effects are primarily discussed and analyzed in qualitative terms addressing:

- Recreation patterns of residents of Tuolumne and Mariposa counties.
- Recreation that draws visitors from beyond the two-county area, and contributes to the local tourism industry and the rural Sierra lifestyles it supports.
- Rural mountain lifestyles supported by the forest products industry.
- Rural lifestyles based on ranching, including reliance on grazing allotments in the Rim Fire area.
- Pressures on population growth in Mariposa and Tuolumne counties.
- Potential for any effects involving environmental justice concerns.

Affected Environment

For socio-economic analysis, the primary environment impacted by the Rim Reforestation project actions is defined by the two counties that contained the fire: Tuolumne and Mariposa. The resident populations have lived in a culture that has a long history of forest products industries. Over time the counties have built up an infrastructure supporting the forest industries including lumber mills, energy co-generation plants, contractor companies, and an inventory of mechanical equipment that is used within the forests. This infrastructure relies on a long-term steady supply of growing trees and merchantable timber that requires periodic reforestation activities and decades of maintenance and care.

In addition to forest products, Tuolumne and Mariposa counties have also fostered a culture including ranching and grazing, and other resource-based economic activities, such as mining. Residents also value the recreational opportunities provided by the NFS lands close to home.

In addition, the affected counties have a long history of serving a tourism industry that has Yosemite National Park as the largest attraction in the vicinity. The industry also relies on recreational opportunities in the National Forest, including many within the Rim Fire burn area. The area includes a special type of tourism associated with a collection of summer camps and private resorts that were impacted by the Rim Fire.

Existing Conditions

POPULATION

Table 3.10-3 shows rapid growth in the affected environment during the 1970s and 1980s. The population of Tuolumne and Mariposa Counties grew much faster than the state as a whole during those decades. The relative growth rate slowed during the 1990s, however, and since 2000 the counties have grown much slower than the state.

Table 3.10-3 Historical Population by County for U.S. Census Years: 1970 – 2010

County or Region	1970	1980	1990	2000	2010
Mariposa	6,015	11,108	14,302	17,130	18,251
Tuolumne	22,169	33,928	48,456	54,504	55,365
Total 2-Co. Region	28,184	45,036	62,758	71,634	73,616
10-Year Growth		60%	39%	14%	3%
California	19,971,069	23,667,764	29,760,021	33,871,653	37,253,956
10-Year Growth		19%	26%	14%	10%

Source: California State Data Center, Demographic Research Unit, Department of Finance

Table 3.10-4 shows growth is expected to occur at a slower rate than the state average in coming decades as well. Today Tuolumne is by far the larger of the two counties, and coupled with the location of the majority of the Rim Fire area, the majority of the primary socio-economic impacts from reforestation activities would be felt in Tuolumne County.

Table 3.10-4 Projected Population by County for 10-Year Periods: 2015 – 2055

County or Region	2015	2025	2035	2045	2055
Mariposa	18,147	20,520	21,288	20,949	20,334
Tuolumne	54,628	57,278	59,560	59,767	59,966
Total 2 Co. Region	72,775	77,798	80,848	80,716	80,300
10-Year Growth		7%	4%	0%	-1%
California	38,896,969	42,373,301	45,747,645	48,574,095	50,817,750
10-Year Growth		9%	8%	6%	5%

Source: California State Data Center, Demographic Research Unit, Department of Finance

ENVIRONMENTAL JUSTICE CONCERNS

Some demographic data for the affected environment describe the context for evaluating environmental justice concerns. Executive order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," signed February 11, 1994 by President Clinton states (Section 1-101), "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States."

For environmental justice analysis, Table 3.10-5 presents the ethnic distribution of the two-county population that defines the region of socioeconomic impact. The ethnic distribution of the California state population is also presented for comparison purposes. Tuolumne and Mariposa counties have very similar ethnic profiles, and both contain distinctly fewer minorities than the state as a whole, with the one exception that Native Americans are slightly more heavily represented locally than statewide.

Table 3.10-5 Ethnic Minority Populations in the Region of Impact

Ethnic Identity	Tuolumne County	Mariposa County	California
White alone, percent, 2013 (a)	91.1%	90.2%	73.5%
Black or African American alone, percent, 2013 (a)	2.1%	1.1%	6.6%
American Indian and Alaska Native alone, percent, 2013 (a)	2.2%	3.3%	1.7%
Asian alone, percent, 2013 (a)	1.3%	1.4%	14.1%
Native Hawaiian and Other Pacific Islander alone, percent, 2013 (a)	0.2%	0.2%	0.5%
Two or More Races, percent, 2013	3.2%	3.8%	3.7%
Hispanic or Latino, percent, 2013 (b)	11.2%	10.0%	38.4%
White alone, not Hispanic or Latino, percent, 2013	81.6%	81.8%	39.0%

Source: U.S. Census Bureau
(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.

Environmental justice concerns can also focus on low-income populations. Similarly, age discrimination can be an issue for the Civil Rights Act. Table 3.10-6 presents the key age and income characteristics. The two-county region has fewer families with young children than the state average, and has dramatically more people of retirement age than the state average. Incomes by all measures are lower in Tuolumne and Mariposa Counties than for similar measures statewide. In spite of that, proportionately fewer people are living below the poverty line in the more populous Tuolumne County than the statewide average. The poverty percentage in Mariposa County, however, has recently exceeded that of the state average.

Table 3.10-6 Age, Income and Poverty Characteristics in the Region of Impact

Key Age and Income Characteristics	Tuolumne County	Mariposa County	California
Population, 2014 estimate	53,831	17,682	38,802,500
Persons under 5 years, percent, 2013	4.1%	4.2%	6.5%
Persons under 18 years, percent, 2013	16.9%	16.9%	23.9%
Persons 65 years and over, percent, 2013	22.8%	23.7%	12.5%
Per capita money income in past 12 months (2013 dollars), 2009-2013	$25,943	$26,988	$29,527
Median household income, 2009-2013	$48,426	$49,820	$61,094
Persons below poverty level, percent, 2009-2013	14.5%	16.1%	15.9%

Source: US Census Bureau

INDUSTRIAL PROFILE OF THE REGIONAL ECONOMY

Table 3.10-7 (Tuolumne County) and Table 3.10-8 (Mariposa County) present the historical perspective, and the most recent available profile, of the structure of the regional economy. The industry sector for "Mining and Logging" is much larger in Tuolumne County, and almost non-existent in Mariposa County. The dramatic decline in employment in the Mining and Logging sector from 1990 through 2010 can also be seen in Tuolumne. In recent years, however, it appears the industry has stabilized. Employment in sawmills is included in the "Manufacturing" sector of the economy.

It does not appear from these tables that there are large pools of labor in either county that are dedicated to the type of treatments proposed to be performed on forest lands. A search of data collected by the U.S. Census Bureau for their data series County Business Patterns reveals that in the entire state of California, there are only 80 business providing “Support activities for forestry” (NAICS Code 115310), and in the most recent count had only approximately 500 people employed in those activities. In contrast, in spite of having a much smaller population and economy, the state of Oregon has an industrial cluster of over 200 such contractor businesses, with closer to 3,000 forest labor employees. This corroborates anecdotal evidence that many of the experienced contractors available to conduct forest work in Tuolumne and Mariposa counties are actually based in Southern Oregon.

Table 3.10-7 Tuolumne County Industry Employment and Labor Force by Annual Average

Industry Title	1990	2000	2010	2011	2012	2013	2014
Civilian Labor Force	19,870	22,910	22,600	22,720	22,360	21,680	21,640
Civilian Employment	18,530	21,560	19,160	19,430	19,450	19,330	19,750
Civilian Unemployment	1,340	1,350	3,440	3,280	2,900	2,350	1,890
Civilian Unemployment Rate	6.7%	5.9%	15.2%	14.5%	13.0%	10.8%	8.7%
Total, All Industries	14,200	15,990	15,940	16,200	16,240	16,350	16,840
Total Farm	90	180	60	60	50	50	60
Total Nonfarm	14,120	15,800	15,880	16,140	16,190	16,300	16,780
Total Private	10,210	11,270	10,570	10,970	10,960	11,070	11,440
Goods Producing	2,320	2,250	1,340	1,490	1,450	1,460	1,470
Mining and Logging	400	200	130	160	110	120	130
Construction	1,080	920	540	510	510	490	510
Manufacturing	850	1,130	680	830	830	850	830
Durable Goods	730	890	490	630	660	680	670
Nondurable Goods	110	240	190	200	170	170	160
Service Providing	11,800	13,550	14,540	14,650	14,730	14,830	15,320
Private Service Providing	7,890	9,010	9,220	9,480	9,500	9,610	9,980
Trade, Transportation and Utilities	2,380	2,840	2,330	2,420	2,480	2,510	2,670
Wholesale Trade	190	150	190	120	140	140	140
Retail Trade	2,020	2,490	1,970	2,110	2,140	2,160	2,300
Transportation, Warehousing and Utilities	170	200	180	190	210	220	230
Information	200	230	240	210	210	210	230
Financial Activities	790	550	520	510	520	550	560
Professional & Business Services	880	890	930	930	930	920	910
Educational & Health Services	1,130	1,740	2,780	2,930	2,910	2,820	2,910
Leisure & Hospitality	1,960	2,130	2,040	2,060	1,980	2,130	2,210
Other Services	550	630	380	430	470	480	500
Government	3,910	4,540	5,310	5,170	5,230	5,220	5,340
Federal Government	560	370	440	420	480	480	520
State and Local Government	3,350	4,170	4,870	4,750	4,750	4,740	4,820
State Government	1,160	1,110	1,260	1,190	1,130	1,080	1,140
Local Government	2,190	3,060	3,610	3,560	3,630	3,660	3,680

Source: California Employment Development Department, Labor Market Information Division

The relative health of the regional economy can also be inferred from comparisons with the state average for unemployment rate. Using the same data sources and methods as shown in Table 3.10-7 and Table 3.10-8, the State of California had an unemployment rate of 7.5% last year in 2014. With 2014 unemployment rates of 8.7% and 8.8% respectively, somewhat more distress currently exists in the economies of both counties according to the most recent data available. Since the turn of the century in 2000, both counties have consistently experienced somewhat higher unemployment rates than the average for the state as a whole.

Table 3.10-8 Mariposa County Industry Employment and Labor Force by Annual Average

Industry Title	1990	2000	2010	2011	2012	2013	2014
Civilian Labor Force	6,780	7,980	8,740	8,690	8,410	8,200	8,130
Civilian Employment	6,390	7,490	7,610	7,550	7,390	7,330	7,410
Civilian Unemployment	380	490	1,130	1,140	1,030	860	710
Civilian Unemployment Rate	5.7%	6.2%	12.9%	13.1%	12.2%	10.5%	8.8%
Total, All Industries	4,790	4,930	5,430	5,390	5,250	5,280	5,370
Total Farm	30	10	20	20	20	20	20
Total Nonfarm	4,760	4,920	5,420	5,380	5,230	5,260	5,350
Total Private	3,330	3,190	3,230	3,230	3,180	3,310	3,410
Goods Producing	430	300	240	240	250	250	280
Private Service Providing	2,910	2,890	2,990	2,990	2,930	3,050	3,130
Mining and Logging	10	20	10	10	10	20	20
Construction	250	160	110	110	120	130	150
Manufacturing	160	120	120	120	120	100	110
Service Providing	4,340	4,620	5,180	5,130	4,980	5,010	5,080
Trade, Transportation and Utilities	370	340	330	330	330	350	400
Wholesale Trade	20	10	10	10	20	20	20
Retail Trade	340	320	270	280	270	290	330
Transportation, Warehousing and Utilities	10	10	50	40	40	40	40
Professional and Business Services	100	250	170	170	160	140	120
Educational and Health Services	230	190	250	260	280	330	380
Leisure and Hospitality	1,920	1,930	2,130	2,080	1,990	2,010	1,990
Private Service Providing - Residual	290	180	120	140	170	220	240
Government	1,430	1,730	2,190	2,140	2,060	1,960	1,940
Federal Government	570	620	850	830	800	730	710
State and Local Government	860	1,110	1,340	1,320	1,260	1,230	1,240
State Government	150	170	180	170	160	160	190
Local Government	710	940	1,160	1,150	1,090	1,070	1,050

Source: California Employment Development Department, Labor Market Information Division

RESOURCE BASED INDUSTRIES AND LIFESTYLES IN THE REGION OF IMPACT

The lumber industry has historically been one of the main resource based sources of employment in Tuolumne and Mariposa Counties, and has contributed to the rural lifestyles available there. It has been in a long-term decline in recent decades, however. California’s timber harvest peaked in 1955 at 6 billion board feet. The trend in total industry volume statewide has been down ever since, although it was still almost 5 billion board feet in the late 1980s, just 25 years ago. The number of sawmills in the state was over 100 at that time, but has declined dramatically to 25 with a smattering of other wood product plants that utilize a small percentage of logs from the forest. This has reduced the number of mills within the local region around the Rim Fire burn area as well. On the other hand, the reduction in milling capacity in California has not declined as rapidly as the number of mills, because it has been the smaller, less efficient mills that have ceased operations. Even so, the bottleneck in the industrial process for turning standing trees in Tuolumne and Mariposa Counties into lumber remains due to the combined capacities of the sawmills within reach. Other steps in the industrial process are more scalable and flexible. For example, more logging and trucking contractors can be brought into the region from further away if needed.

A more recent resource based economic activity is the innovation of the biomass power generation industry. Conceived as a more environmentally sensitive way to reduce unwanted fuel loads in the forests, biomass is burned within contained plants and used to generate electrical power. At this time, the biomass industry has a significant infrastructure of existing plants within 90 to 120 miles of the

Rim Fire burn area. Future power generation, and the future health of the biomass industry, relies in part on the continued supply of fuel from the forest. From the perspective of reduction of excess fuels from the forest, there are also clearly ecosystem value benefits to be gained by hauling and burning biomass in power plants that can contain a majority of the particulates and greenhouse gases, rather than burning the material in open piles on site.

Ranching and livestock grazing has also been a traditional component in the local economy, and has contributed to the rural culture and lifestyle of Tuolumne and Mariposa counties.

Native American people have gathered plant materials and visited specific areas within the burn zone. Their use of the area may have been affected by the impacts of the Rim Fire on the resources.

RECREATION/TOURISM INDUSTRY IN THE REGION OF IMPACT

The portion of the Stanislaus National Forest affected by the Rim Fire, has a long history of recreational use. One of the social and cultural attractions for living in Tuolumne and Mariposa Counties has been the presence of recreational opportunities on the National Forest close to home.

The Rim Fire area has also historically been used extensively by non-locals. One of the reasons for this is that Highway 120, passing through the burn area, is one of the major gateways to Yosemite National Park, which has generated recreation related tourism and economic impacts in multiple ways. Some people have spent a portion of their money in the area as they passed through to their primary destination in Yosemite. Others were not able to secure overnight accommodations in the park, and instead stayed in other accommodations within the burn area, such as camping on the National Forest, and made day trips into Yosemite. Yet others found that Tuolumne River rafting (a Class 5 experience) or other recreational offerings in the burn area were sufficiently attractive to warrant extending their visit to Yosemite by one or more days in the Stanislaus. The Stanislaus has also been the primary destination for many non-locals who were motivated by the recreational activities to be had there, without visiting Yosemite at all during the same trip.

Examples of the activities historically available within the Rim Fire burn area that have drawn both locals and non-locals, in roughly descending order of participation in each activity include:

- Viewing natural features
- Hiking / walking
- Viewing wildlife
- Picnicking
- Driving for pleasure
- Fishing
- Developed camping
- Motorized trail activity
- OHV use
- Hunting
- River rafting (non-motorized water sports)
- Resort use
- Primitive camping

The environment within the burn area has changed dramatically since the fire. Recreation patterns have been affected. For some, the aftermath of the Rim Fire and the flora and fauna that are emerging may be a new draw and increase their interest in visiting the area. For example, a new attraction being marketed in the Bay Area is the 42-mile driving tour of the Rim Fire area, complete with downloadable map and 11 audio files. For many other recreationists, however, the loss of their favorite spot in the forest and the changes to their favored recreational use may have diminished their incentive to visit.

The Rim Fire also affected a variety of summer camps, private resorts, and other recreational facilities operated by other public agencies, private non-profit groups, and private for-profit entities including:

- City of Berkeley Tuolumne Camp
- San Francisco Camp Mather
- The City of San Jose Camp
- Camp Tawonga
- Evergreen Lodge
- Other facilities

A majority of the Berkeley-Tuolumne Camp was destroyed by the Rim Fire and is currently not available for use pending permits and reconstruction. To the extent the visitor accommodating capacity or recreational attractiveness of the area has been diminished, there has been a proportionate decrease in the size of the visitor-serving economy in Tuolumne County, and there have also been social and cultural impacts on the groups that have traditionally visited the area.

Forest Service Fiscal Environment

Economic efficiency is important for all federal expenditures of taxpayer dollars, but recent trends in the costs of fighting wildfires have focused federal attention on the allocation of fiscal resources within the Department of Agriculture, and within the Forest Service specifically. As highlighted in a USDA report "The Rising Cost of Fire Operations: Effects on the Forest Service's Non-Fire Work" issued on August 5, 2015, for the first time in its history the Forest Service is spending more than half of its $5 billion annual budget battling wildfires, including preparedness, suppression, FLAME, and related programs. As stated in the report:

> "In 1995, fire made up 16% of the Forest Service's annual appropriated budget—this year, for the first time, more than 50% of the Forest Service's annual budget will be dedicated to wildfire. Along with this shift in resources, there has also been a corresponding shift in staff, with a 39% reduction in all non-fire personnel. Left unchecked, the share of the budget devoted to fire in 2025 could exceed 67%, equating to reductions of nearly $700 million from non-fire programs compared to today's funding levels. That means that in just 10 years, two out of every three dollars the Forest Service gets from Congress as part of its appropriated budget will be spent on fire programs."
>
> "As more and more of the agency's resources are spent each year to provide the firefighters, aircraft, and other assets necessary to protect lives, property, and natural resources from catastrophic wildfires, fewer and fewer funds and resources are available to support other agency work—including the very programs and restoration projects that reduce the fire threat."

Environmental Consequences

Alternative 1 (Proposed Action)

Direct and Indirect Effects

The proposed action addresses all the purposes and needs and is composed of the full set of activity groups, the largest of which is focused on reforestation, but also includes deer habitat enhancement, thinning existing plantations for ICO structure and fuels reduction, and noxious weed eradication. Some of the specific treatments are capital intensive such as use of feller bunchers for cutting dead and live trees and heavy equipment tractors for deep tilling, and others are labor intensive such as hand cutting and piling of fuels and hand spraying of herbicides.

Economic Efficiency

The estimated costs per acre of each type of treatment (presented above in Table 3.10-1) have been multiplied by the number of acres subject to each treatment as they are scheduled to occur over the coming 10 to 15 years, in accordance with the schedule tables presented in Appendix F for each of the action alternatives. For each of the first 14 years under Alternative 1, the Forest Service would incur the majority of its costs to hire contractors to perform treatments and have additional in-house agency costs to conduct burns, perform survival exams, and other monitoring of the contractors. The resulting total costs of treatment performed by contractors and by Forest Service staff by year are presented in the second and third columns of Table 3.10-9. The total cost to the government to be incurred each year is presented in the fourth column.

To accurately compare costs that occur over a number of future years with benefits derived from the proposed action, however, the PNC must be calculated. Using the discount rates specified for use during 2015 for federal decisions, the PNC for Alternative 1 is calculated in the last column of Table 3.10-10. The total PNC of performing scheduled treatments under Alternative 1 over the next decade and a half is approximately $83 million.

Table 3.10-9 Alternative 1: Present Net Cost of Treatments

Year	Contractor Costs (2015 $1,000s)	Agency Costs (2015 $1,000s)	Total Costs	Discount Rate[1]	Discount Factor[2]	Present Net Cost (PNC)
1	$732	$59	$790	0.00%	100.00%	$790
2	$3,916	$2,153	$6,069	0.05%	99.90%	$6,063
3	$8,595	$2,071	$10,666	0.10%	99.70%	$10,634
4	$9,200	$3,508	$12,708	0.25%	99.01%	$12,582
5	$9,874	$2,648	$12,523	0.40%	98.02%	$12,275
6	$9,758	$1,193	$10,951	0.55%	96.76%	$10,596
7	$8,643	$1,246	$9,889	0.70%	95.23%	$9,417
8	$6,421	$1,246	$7,666	0.77%	94.05%	$7,210
9	$3,894	$677	$4,571	0.83%	92.83%	$4,243
10	$3,508	$634	$4,141	0.90%	91.43%	$3,786
11	$1,968	$437	$2,405	0.93%	90.32%	$2,172
12	$2,127	$473	$2,600	0.96%	89.17%	$2,318
13	$159	$35	$195	0.99%	87.98%	$171
14	$696	$155	$850	1.02%	86.76%	$738
Totals	**$69,489**	**$16,534**	**$86,024**			**$82,997**

Source: Land Economics Consultants analysis

[1] Discount rates for federal analyses are presented in Appendix C of OMB Circular A-94 for key years, and discount rates for intervening years are estimated through linear interpolation.

[2] The Discount Factor is equal to $1/(1 + i)^t$ where i is the interest rate and t is the number of years from the date of initiation for the program or policy until the given future year.

The PNB from Alternative 1 that can be realized in dollars paid to the government is derived from the ultimate sale of forest products to private industry, either during thinning operations over the coming decade or from commercial timber sales once the desired sustainable forest conditions are achieved 50 to 60 years from now. The volumes of timber likely to be produced by the treatment regimen, and the point in the future when such products might be available are estimated in Table 3.10-10. For purposes of developing a standard methodology for comparing alternatives, the future projections stop after the first round of commercial harvests, conducted in 50 to 60 years, but it should be noted that the mature stand of trees created by that point in time would continue to grow and add biomass, and that on a sustainable basis additional commercial timber harvests would occur far into the future, perhaps occurring next around year 100, and then again in year 150. The longer the time horizon, the more the PNB will grow due to the repeat entries to harvest larger and larger trees.

The PNV is the single best statistic for quantifying the economic efficiency of the proposed action, including both the discounted benefits received in the future from the action and the discounted costs of treatments that produce the desired future forest conditions. For the alternatives calling for dramatic action on the part of the government to replant and manage the forest over the next decade or so, it should be expected that dollar costs would be larger than dollar benefits recouped by the federal government in selling forest products to private industry. This is because the desired forest conditions are designed to also generate many other benefits that are not captured in the dollar exchanges between the government and the private sector economy, such as enhanced habitat quality, carbon sequestration, reduced risk of wildfires, recreational opportunities, and other ecosystem values.

Given the PNB of $7.9 million estimated above, less the PNC of negative $83.0 million, the PNV for Alternative 1 is negative $75.1 million. The larger the PNV, the more beneficial it is to the federal goal of economic efficiency. In the case of expensive action alternatives, the larger PNV is the one that is “less negative.”

Table 3.10-10 Alternative 1: Present Net Benefits Derived from Thinning or Harvesting Timber

Years	Thin/Harvest (acres)	Estimated Yield (board feet/acre)	Produced (MBF)	Value Sold (in $1,000s)	Discount Rate	Discount Factor	Present Net Benefit (PNB in $1,000s)
1	6	305	2	$0.2	0.00%	100.00%	$0.2
2	33	305	10	$1	0.05%	99.90%	$1
3	1,164	305	355	$36	0.10%	99.70%	$35
4	2,561	305	781	$78	0.25%	99.01%	$77
5	5,911	305	1,803	$180	0.40%	98.02%	$177
6	4,136	305	1,261	$126	0.55%	96.76%	$122
7	123	305	38	$4	0.70%	95.23%	$4
50	10,786	4,998	53,907	$5,391	1.40%	49.90%	$2,690
60	12,644	8,664	109,546	$10,955	1.40%	43.42%	$4,757
Totals	**37,365**	**15,796**	**590,223**	**$16,770**			**$7,863**

Source: Land Economics Consultants analysis

Economic Impact

The funds the federal government would pay private contractors to conduct forest treatments within the Rim Fire burn area would temporarily expand the two-county regional economy. Given that there are few contractor businesses within Tuolumne or Mariposa counties set up to perform the required treatment activities, it is likely that many of the contracts would be awarded to firms from outside the area. While some may be from other California counties, others would likely come out of the industrial cluster resident in Oregon. More of the money paid to contractors would “leak out” of the regional economy immediately if they are not based locally, but nevertheless some would remain in the two-county region, and direct jobs within the counties would be created for the duration of the contract work.

In addition, contractors from outside the area would need to rent motel rooms or otherwise house their workforce locally while the work is being performed, employees would buy meals and other sundry retail goods, and contractor firms would buy gas, oil, parts, supplies, and other inputs from local businesses. All of this activity would create business volume, personal income, gross regional product, and local tax revenue within Tuolumne and Mariposa Counties.

The best single indicator of this general economic expansion for comparing between alternatives is job creation, which is highly correlated with all of the other measures of economic health. In Table 3.10-11 the consistent methodology is applied, where half the contract cost is assumed to go to wages for workers, and wages are projected to average $44,000 per year to equal full-time-equivalent jobs. Half again as many indirect and induced jobs are then created locally through multiplier effects. Alternative 1 is estimated to support 200 to 300 jobs per year in the two-county area in the coming half dozen or so years, tapering off a decade from now, but totaling over $2,350 throughout the treatment period. Job creation is a beneficial impact on the two-county regional economy.

Table 3.10-11 Alternative 1: Jobs Created in Tuolumne and Mariposa Counties

Year	**Contractor Costs** (2015 $1,000s)	**Direct Jobs** (FTEs) [1]	**Indirect and Induced Jobs** (FTEs) [2]	**Total Jobs Supported** (FTEs)
1	$732	17	8	25
2	$3,916	89	44	133
3	$8,595	195	98	293
4	$9,200	209	105	314
5	$9,874	224	112	337
6	$9,758	222	111	333
7	$8,643	196	98	295
8	$6,421	146	73	219
9	$3,894	88	44	133
10	$3,508	80	40	120
11	$1,968	45	22	67
12	$2,127	48	24	73
13	$159	4	2	5
14	$696	16	8	24
Totals	**$69,489**	**1,579**	**790**	**2,369**

Source: Land Economics Consultants analysis
[1] Assuming 50% of contractor costs go to labor, and mean annual wages are $44,000.
[2] Given an employment multiplier of 1.5, another half an FTE job is created in the 2-county region for every direct FTE job created.

The costs of Agency activities (e.g., conducting prescribed burns and surveying forests) would support jobs within the Forest Service, but the conservative assumption is made here that none of these are net new jobs, but rather reflect Agency priorities and the allocation of time for people that would be on staff regardless. In an ideal outcome, federal appropriations or other monies such as grants and sponsorships would be forthcoming allowing the Stanislaus to add 10 or more new people dedicated to Rim Reforestation activities.

Social Analysis

The proposed action (Alternative 1) would restore a mixed conifer forest far more rapidly than taking no action (Alternative 2). Forest resource based economic activities and the rural lifestyles that are supported by them would be enhanced by Alternative 1. The ranching lifestyle for families, that have grazing allotments within the burn area, would be enhanced somewhat by proposed site preparation and tree thinning treatments that impede range stock movement, and by reducing noxious weeds. The treatments and the more rapid return of a mixed conifer forest would help maintain the industrial capacity of the forest products and biomass energy industries and the rural lifestyles they support in the two-county area.

Recreation within the Rim Fire area, although perhaps in differing forms, would likely take place with or without the Forest Service taking action. To the extent that return of a mixed conifer forest would have greater appeal to a wider range of traditional recreational pursuits and draw more tourists back to the forest, residents of the region who own businesses or work in the tourism industry would see some restoration of lifestyles that have been diminished by the reduced volumes of visitors resulting from the Rim Fire.

CUMULATIVE EFFECTS

Past actions in the region of impact, and throughout California, have led to a reduction in the size of the forest products industry with a specific capacity bottleneck in number of sawmills available to process logs into lumber. The mills that remain today tend to be the larger and more efficient ones. Even so, the capacity of the existing private industry infrastructure to mill lumber is far below historical highs.

The Rim Fire burned over a quarter million acres including private forest lands and forest inside Yosemite National Park. Recent past actions contributing to cumulative effects include the emergency salvage logging of over 18,000 acres of private timber land and over 28 miles of roadside hazard tree removal in Yosemite (over 800 acres). In addition, three National Forest timber sales were in progress on over 2,000 acres when the fire broke out, and have been continued, although at reduced scales in some instances. With a surge in available supply and limits to processing capacity, the prices private industry has been prepared to pay for salvaged or green trees have dropped to very low levels. Forest Service sales of timber salvaged from the Rim Fire area generated a fraction of the revenue seen after other large scale fires on the Forest from 1987 through 2007.

Ongoing activities include continued treatments to reduce fuels on over 25,000 acres in the Rim Recovery area and several thousand acres of green tree thinning in other project areas. Foreseeable future actions include about 4,000 acres of green tree thinning in the Twomile Ecological Restoration area, the Reynolds Creek Stewardship area and other project areas.

All of these contribute demand on private industry infrastructure available to conduct treatments in the forests, thin green trees, haul raw materials, and produce lumber, energy and other forest products. There are several cumulative economic effects that would likely be produced by this situation:

- In the short-term, capacity is limited. Given the recent surge in raw materials available from salvage logging combined with new green tree thinning and fuels reductions, downward pressure will continue to be maintained on the prices for raw materials. This can be seen as a beneficial economic impact by buyers, such as sawmills and power plants, and an adverse economic impact by sellers, such as the Forest Service.
- With continued softness in demand and low prices paid, it is possible that the Forest Service would not be able to sell as many green trees as they are hoping for to offset costs of thinning in some units. Although the overall impact of conducting the treatments proposed in Alternative 1 would be beneficial to the local economy regardless of the source of funding to pay for treatments, if the Forest Service is unable to offset some of the costs of thinning through sale of green trees it would represent higher cost to taxpayers and lower economic efficiency.
- Another possible outcome is that thinning would be deferred until the demand and prices for green trees have recovered sufficiently to fund the activities. While that may make economic sense, in the interim the forest will be more vulnerable to fire and infestation.
- In the long run, implementing Alternative 1 in conjunction with other present and foreseeable actions would serve as a stimulus to expand the capacity of the industry, potentially including forming new businesses to conduct labor intensive treatments, hiring of work crews, and investing in new equipment. Additional hiring and business formation would be seen as a beneficial impact on the local economy. For significant industry expansion to take place, however, the perception would have to be that there is some assurance that sufficient funding will be available in future years to continue with the scheduled treatments and programs.

Reasonably foreseeable future actions include replanting in campgrounds, reconstruction of the City of Berkeley Tuolumne Camp, trails networks for both OHV and non-motorized uses and other environmental improvements that enhance the attractiveness and capacity of the area for recreation. In combination with foreseeable actions, Alternative 1 would further expand the capacity of the tourism industry based along Highway 120, and incomes and jobs in visitor serving businesses in Tuolumne County would increase as a result. Because the Highway 120 corridor also serves as one of the major gateways to Yosemite National Park, Alternative 1 could also expand visitation to Yosemite somewhat, for example by encouraging people to stay overnight in campsites in the Rim Fire area and become day visitors to Yosemite Valley. From a cumulative perspective, this could have a beneficial impact on direct tourism employment gains in Tuolumne and Mariposa Counties, as well as additional beneficial indirect economic impacts through multiplier mechanisms.

Continuation of the 14 existing grazing allotments is included in the ongoing and foreseeable future actions, and the rural ranching lifestyle it supports should be maintained among the cumulative effects.

Economic efficiency will continue to be a high priority for the Forest Service. A USDA August 4, 2015 report states:

> "Climate change has led to fire seasons that are now on average 78 days longer than in 1970. The U.S. burns twice as many acres as three decades ago and Forest Service scientists believe the acreage burned may double again by mid-century. Increasing development in fire-prone areas also puts more stress on the Forest Service's suppression efforts."
>
> "While the Forest Service and its firefighting partners are able to suppress or manage 98% of fires, catastrophic mega-fires burn through the agencies resources: 1% to 2% of fires consume 30% or more of annual costs. Last year, the Forest Service's 10 largest fires cost more than $320 million dollars. The cost of fire suppression is predicted to increase to nearly $1.8 billion by 2025. This trend of rising fire suppression costs is predicted to continue as long as the 10-year average serves as the funding model and presents a significant threat to the viability of all other services that support our national forests."
>
> "This unsustainable problem is made worse because in many years, fighting fires costs more than was planned for that year, requiring mid-season transfers of additional dollars from already depleted accounts to pay for firefighting: a practice referred to as 'fire transfer.' In some cases, the agency is forced to divert money away from the same forest restoration projects that prevent or lessen the impacts of future wildfire. While Congress typically provides supplemental resources to replenish the Forest Service budget after fire transfers, transfers remain extremely problematic as they disrupt seasonal work, frustrate partners, and delay vital work."

The increase in employment opportunities, both from conducting treatments to forest units and from restoration of some of the tourism industry, would place upward pressure on populations in Tuolumne and Mariposa Counties. Given that some unemployment and underemployment already exists in the area, and that some of the jobs may be taken by seasonal or temporary workers, the growth in permanent population of the two-county area due to any of the action alternatives is likely to be minor and indistinguishable from organic growth.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

Under Alternative 2 no treatments would be performed within the Rim Fire area beyond management as guided by current decisions and plans. The return of a mixed conifer forest would be delayed the longest under Alternative 2. Only natural regeneration would return forests to the landscape, taking hundreds of years to reach maturity in some areas, especially where mature green conifers are non-existent. Fuels reduction treatments beyond those planned under other analysis would not be performed, no thinning would occur in older plantations to remove standing biomass and saw logs, and noxious weeds would persist and spread throughout the area.

Economic Efficiency

No action means no revenue would be generated to the government from sale of trees removed during thinning operations within existing plantations over the next decade. With natural regeneration alone it would also take longer to produce merchantable timber in the areas proposed for planting, and would likely be at lower volumes per acre. The PNB of selling timber under the no action alternative is estimated in Table 3.10-12. The same format as Table 3.10-10 for Alternative 1 is used for comparability, and it can be seen that no government income occurs in years 1 through 7, but there still would be some revenue from timber sales occurring 50 or 60 years from now, estimated to be worth approximately $1.9 million when expressed as PNB.

Table 3.10-12 Alternative 2: Present Net Benefits Derived from Thinning or Harvesting Timber

Years	Thin/Harvest (acres)	Estimated Yield (board feet/acre)	Produced (MBF)	Value Sold (in $1,000s)	Discount Rate	Discount Factor	Present Net Benefit (PNB in $1,000s)
1	0	0	0	$0	0.00%	100.00%	$0
2	0	0	0	$0	0.05%	99.90%	$0
3	0	0	0	$0	0.10%	99.70%	$0
4	0	0	0	$0	0.25%	99.01%	$0
5	0	0	0	$0	0.40%	98.02%	$0
6	0	0	0	$0	0.55%	96.76%	$0
7	0	0	0	$0	0.70%	95.23%	$0
50	1,504	4,451	6,693	$669	1.40%	49.90%	$334
60	6,062	5,840	35,405	$3,540	1.40%	43.42%	$1,537
Totals	**7,566**	**10,291**	**77,862**	**$4,210**			**$1,871**

Source: Land Economics Consultants analysis

Although the Forest Service would not have to incur the direct costs of having contractors and agency staff perform treatments under Alternative 2, the Forest Service would also have a higher cost of fighting future fires in the Rim Fire area. None of the standing biomass and dead woody fuels would be removed from the thinning units leaving extra fuel in these stands, hindering firefighting and future fire control. With unmanaged fuel loads, the costs of suppressing a fire in such conditions would likely be higher than fighting a wildfire in a managed forest. The PNC of Alternative 2 could be lower than for the action alternatives with luck during fire seasons, but could also be much higher due to unpredictable fires.

Adhering strictly to the standard methodology adopted for comparing the economic efficiency of each alternative, the positive PNV of Alternative 2 is $1.9 million; i.e., a PNB of $1.9 million with a PNC reflecting zero costs of prescribed treatments. This could be seen as a beneficial effect for the federal government, although it ignores any differences in values that are not captured in dollar terms, such as enhanced habitat quality, carbon sequestration, and other ecosystem values.

It is possible that the PNC for Alternative 2 could be significantly negative due to the higher costs of fighting a wild fire in areas with large amount of standing dead trees. The cost of fighting the last fire in the Rim Fire burn area was estimated to be over $125 million. This would be an adverse effect.

Economic Impact

Under Alternative 2, no contracts would be forthcoming for private firms to conduct treatment actions. No direct new job support would be created, and no indirect and induced jobs would be created in the two-county area. Compared with action alternatives, this would be perceived as an adverse economic impact.

Social Analysis

For some people a forest that develops through natural regeneration may be a more desirable option because it costs less, minimizes human interference, does not require herbicides, benefits some species of wildlife, or enhances recreational wildlife watching for the specific species benefited. The difficulty would be moving through or even seeing through heavy brush areas that may be impenetrable due to the density of the returning vegetation (e.g. the 1987 Larson Fire on the Groveland Ranger District). In addition, natural regeneration could take centuries to reforest parts of the Rim Fire where few live overstory conifers survive post fire. For others, the naturally regenerating recreational environment may be less attractive than a more rapidly returning mixed conifer forest. From the perspective of visitors and residents who were used to the way the forest looked and functioned before, the natural regeneration environment will certainly be different. Historical recreational patterns and traditional resident social life have already been disrupted by the Rim Fire.

Depending on one's recreational preferences and expectations for the forest, Alternative 2 could be seen as either beneficial or adverse.

CUMULATIVE EFFECTS

Present and reasonably foreseeable actions include treatments in other parts of the forest and on private lands in Tuolumne and Mariposa counties that are similar to what are proposed under action alternatives for the Rim Fire area. Without the Rim Reforestation treatments adding additional work, the forest products industry would still continue to exist in Tuolumne and Mariposa counties, but it would be smaller. There would be fewer direct jobs, and fewer indirect and induced jobs in the region, which would constitute an adverse economic effect.

In the longer run, by producing lower volumes of merchantable timber within the Rim Fire zone and delaying maturity until further into the future, there could be additional pressure to close down sawmills, biomass energy plants, or other components of the forest products industry infrastructure within Tuolumne and Mariposa counties, which would also be seen as a long-term adverse effect on the regional economy.

With no related increase in employment opportunities under the no action alternative, there would be no additional pressure on population growth. Tuolumne and Mariposa Counties are likely to continue to grow slowly as they have recently with additional retirees moving in and with other organic growth as households form and people find jobs in other local industries.

Alternative 3

DIRECT AND INDIRECT EFFECTS

Alternative 3 is an attempt to achieve the same desired forest conditions, but without the use of herbicides. From an economic and socio-cultural perspective, this requires much more labor intensive treatments than with the other action alternatives. For example, it takes more time to hand grub unwanted undergrowth around planted tree seedlings than it takes to spray the area with herbicides. Furthermore, it takes multiple repeat grubbings to achieve the same results as a single herbicide application and is less effective at controlling brush even with two treatments a year. As a result, more person-hours of time would be expended in Alternative 3 and costs of hiring contractors to perform these activities would be substantially higher that with other action alternatives.

Economic Efficiency

The same methodology was used to analyze economic efficiency as Alternative 1.

Using the appropriate discount rates, the PNC for Alternative 3 is calculated in the last column of Table 3.10-13. The total PNC of performing scheduled treatments under Alternative 3 over the next decade and a half is approximately $232 million.

As with Alternative 1, the PNB from Alternative 3 that can be realized in dollars paid to the government is derived from the ultimate sale of forest products to private industry, either during thinning operations over the coming decade or from commercial timber sales once the desired sustainable forest conditions are achieved 50 to 60 years from now.

As in Alternative 1, the PNV is the single best statistic for quantifying the economic efficiency of the proposed action. Given the PNB of $2.5 million estimated above, less the PNC of negative $232.1 million, the PNV for Alternative 3 is negative $229.6 million. The larger the PNV, the more beneficial it is to the federal goal of economic efficiency. In the case of expensive action alternatives, the larger PNV would be the one that is "less negative," and as discussed below in the comparison, Alternative 3 is the most negative of all alternatives, and by an order of magnitude.

Table 3.10-13 Alternative 3: Present Net Cost of Treatments

Year	Contractor Costs (2015 $1,000s)	Agency Costs (2015 $1,000s)	Total Costs	Discount Rate[1]	Discount Factor [2]	Present Net Cost (PNC)
1	$959	$59	$1,018	0.00%	100.00%	$1,018
2	$10,597	$2,041	$12,638	0.05%	99.90%	$12,626
3	$19,293	$1,503	$20,795	0.10%	99.70%	$20,733
4	$25,044	$3,311	$28,355	0.25%	99.01%	$28,073
5	$31,856	$2,347	$34,203	0.40%	98.02%	$33,527
6	$37,928	$1,236	$39,164	0.55%	96.76%	$37,896
7	$30,533	$793	$31,325	0.70%	95.23%	$29,832
8	$22,654	$926	$23,579	0.77%	94.05%	$22,176
9	$19,347	$574	$19,921	0.83%	92.83%	$18,492
10	$14,693	$440	$15,132	0.90%	91.43%	$13,836
11	$8,774	$479	$9,253	0.93%	90.32%	$8,357
12	$3,589	$70	$3,659	0.96%	89.17%	$3,262
13	$2,474	$155	$2,628	0.99%	87.98%	$2,312
14	$0	$0	$0	1.02%	86.76%	$0
Totals	**$227,739**	**$13,930**	**$241,670**			**$232,140**

Source: Land Economics Consultants analysis

[1] Discount rates for federal analyses are presented in Appendix C of OMB Circular A-94 for key years, and discount rates for intervening years are estimated through linear interpolation.

[2] The Discount Factor is equal to $1/(1 + i)^t$ where *i* is the interest rate and *t* is the number of years from the date of initiation for the program or policy until the given future year.

Table 3.10-14 Alternative 3: Present Net Benefits Derived from Thinning or Harvesting Timber

Years	Thin/Harvest (acres)	Estimated Yield (board feet/acre)	Produced (MBF)	Value Sold (in $1,000s)	Discount Rate	Discount Factor	Present Net Benefit (PNB in $1,000s)
1	6	305	2	$0	0.00%	100.00%	$0
2	33	305	10	$1	0.05%	99.90%	$1
3	1,164	305	355	$36	0.10%	99.70%	$35
4	2,561	305	781	$78	0.25%	99.01%	$77
5	5,911	305	1,803	$180	0.40%	98.02%	$177
6	4,136	305	1,261	$126	0.55%	96.76%	$122
7	123	305	38	$4	0.70%	95.23%	$4
50	0	0	0	$0	1.40%	49.90%	$0
60	8,136	5,937	48,303	$4,830	1.40%	43.42%	$2,097
Totals	**22,070**	**8,072**	**178,149**	**$5,255**			**$2,514**

Source: Land Economics Consultants analysis

Economic Impact

Similar to Alternative 1, but as Table 3.10-15 shows, far more jobs would be created because of the increased amount of manual labor needed to accomplish the hand grubbing portion of this Alternative. Alternative 3 is estimated to support over 1,000 full-time-equivalent (FTE) jobs per year in the two-county area during periods of peak activity, totaling over 7,700 throughout the treatment period.

Job creation is a beneficial impact on the two-county regional economy, but it could also come with some “growing pains.” Because the work is seasonal, 1,000 jobs expressed as full-time-equivalents could mean that substantially more people than that are required at any one time. Tuolumne and Mariposa Counties are relatively small, and housing and serving a couple thousand workers could impact motel room availability. The surge in occupancy rates would likely be seen as beneficial by motel owners and operators, but to the extent that housing temporary forest workers displaces people who would otherwise have been in the area for recreational/tourism purposes, it could adversely impact the owners and operators of attractions, tour operators, and other segments of the gateway community economies that serve tourists and not workers.

Table 3.10-15 Alternative 3: Jobs Created in Tuolumne and Mariposa Counties

Year	**Contractor Costs** (2015 $1,000s)	**Direct Jobs** (FTEs)[1]	**Indirect & Induced Jobs** (FTEs)[2]	**Total Jobs Supported** (FTEs)
1	$959	22	11	33
2	$10,597	241	120	361
3	$19,293	438	219	658
4	$25,044	569	285	854
5	$31,856	724	362	1,086
6	$37,928	862	431	1,293
7	$30,533	694	347	1,041
8	$22,654	515	257	772
9	$19,347	440	220	660
10	$14,693	334	167	501
11	$8,774	199	100	299
12	$3,589	82	41	122
13	$2,474	56	28	84
14	$0	0	0	0
Totals	**$227,739**	**5,176**	**2,588**	**7,764**

Source: Land Economics Consultants analysis
[1] Assuming 50% of contractor costs go to labor, and mean annual wages are $44,000.
[2] Given an employment multiplier of 1.5, another half an FTE job is created in the 2-county region for every direct FTE job created.

The need for in-house Forest Service staff time would be roughly similar in Alternative 3 as for Alternative 1, and it would be preferable to have additional staff.

Social Analysis

Same as Alternative 1 except that replacing herbicides with hand grubbing eliminates the need for grazing restrictions designed to keep livestock away from treated forage.

CUMULATIVE EFFECTS

Same as Alternative 1.

Alternative 4

DIRECT AND INDIRECT EFFECTS

In terms of human intervention, and its economic repercussions, Alternative 4 falls between the proposed action (Alternative 1) and no action (Alternative 2). Reforestation would occur on less than 3,000 acres, and over 17,000 acres characterized as complex early seral forest would be allowed to develop unassisted except for the use of prescribed fire. In all, prescribed fire would be returned to 15,932 acres over the first decade, with fire reintroduced to a similar acreage in the second decade and then repeated through time. To keep the indicators consistent across all alternatives, only the prescribed fire treatments over the coming 14 years are accounted for in the analyses below.

Economic Efficiency

The same methodology was used to analyze economic efficiency as Alternative 1 Using the appropriate discount rates, the PNC for Alternative 4 is calculated in the last column of Table 3.10-16. The total PNC of performing scheduled treatments under Alternative 4 over the next decade and a half is approximately $30 million.

Table 3.10-16 Alternative 4: Present Net Cost of Treatments

Year	Contractor Costs (2015 $1,000s)	Agency Costs (2015 $1,000s)	Total Costs	Discount Rate[1]	Discount Factor[2]	Present Net Cost (PNC)
1	$155	$1,642	$1,796	0.00%	100.00%	$1,796
2	$918	$1,593	$2,512	0.05%	99.90%	$2,509
3	$2,217	$1,739	$3,956	0.10%	99.70%	$3,944
4	$1,306	$1,743	$3,049	0.25%	99.01%	$3,019
5	$918	$1,797	$2,716	0.40%	98.02%	$2,662
6	$941	$1,802	$2,743	0.55%	96.76%	$2,654
7	$918	$1,797	$2,716	0.70%	95.23%	$2,586
8	$941	$1,802	$2,743	0.77%	94.05%	$2,580
9	$0	$1,593	$1,593	0.83%	92.83%	$1,479
10	$0	$1,593	$1,593	0.90%	91.43%	$1,457
11	$0	$1,593	$1,593	0.93%	90.32%	$1,439
12	$0	$1,593	$1,593	0.96%	89.17%	$1,421
13	$0	$1,593	$1,593	0.99%	87.98%	$1,402
14	$0	$1,593	$1,593	1.02%	86.76%	$1,382
Totals	**$8,315**	**$23,475**	**$31,790**			**$30,330**

Source: Land Economics Consultants analysis

[1] Discount rates for federal analyses are presented in Appendix C of OMB Circular A-94 for key years, and discount rates for intervening years are estimated through linear interpolation.

[2] The Discount Factor is equal to $1/(1 + i)^t$ where i is the interest rate and t is the number of years from the date of initiation for the program or policy until the given future year.

Table 3.10-17 shows the PNB for Alternative 4 and was calculated the same as Alternative 1.

Given the PNB of $2.3 million estimated above, less the negative PNC of $30.3 million, the PNV for Alternative 1 is negative $28.0 million. The larger the PNV, the more beneficial it is to the federal goal of economic efficiency. In the case of expensive action alternatives, the larger PNV is the one that is “less negative.” It is important to remember that only 20% of the area would be reforested under Alternative 4, leaving about 80% to come back naturally over decades and centuries.

Table 3.10-17 Alternative 4: Present Net Benefits Derived from Thinning or Harvesting Timber

Years	Thin/Harvest (acres)	Estimated Yield (board feet/acre)	Produced (MBF)	Value Sold (in $1,000s)	Discount Rate	Discount Factor	Present Net Benefit (PNB in $1,000s)
1	6	305	2	$0	0.00%	100.00%	$0
2	33	305	10	$1	0.05%	99.90%	$1
3	1,164	305	355	$36	0.10%	99.70%	$35
4	2,561	305	781	$78	0.25%	99.01%	$77
5	5,911	305	1,803	$180	0.40%	98.02%	$177
6	4,136	305	1,261	$126	0.55%	96.76%	$122
7	123	305	38	$4	0.70%	95.23%	$4
50	1,504	4,451	6,693	$669	1.40%	49.90%	$334
60	6,062	5,840	35,405	$3,540	1.40%	43.42%	$1,537
Totals	**21,500**	**12,426**	**267,162**	**$4,635**			**$2,288**

Source: Land Economics Consultants analysis

Economic Impact

Although Alternative 4 calls for only minimal human intervention in the forest, the federal government would still pay private contractors to conduct some forest treatments, temporarily expanding the two-county regional economy. Direct jobs within the counties would be created for the duration of the contract work.

As under the other action alternatives, contractors from outside the area would need to rent living space, buy meals and other sundry retail goods, and purchase gas, oil, parts, supplies, and other inputs from local businesses.

In Table 3.10-18, Alternative 4 is estimated to support a total of only about 280 jobs, amounting to a peak of roughly 75 FTE jobs in the most active year of treatments. Job creation is a beneficial impact on the two-county regional economy.

Table 3.10-18 Alternative 4: Jobs Created in Tuolumne and Mariposa Counties

Year	**Contractor Costs** (2015 $1,000s)	**Direct Jobs** (FTEs)[1]	**Indirect & Induced Jobs** (FTEs)[2]	**Total Jobs Supported** (FTEs)
1	$155	4	2	5
2	$918	21	10	31
3	$2,217	50	25	76
4	$1,306	30	15	45
5	$918	21	10	31
6	$941	21	11	32
7	$918	21	10	31
8	$941	21	11	32
9	$0	0	0	0
10	$0	0	0	0
11	$0	0	0	0
12	$0	0	0	0
13	$0	0	0	0
14	$0	0	0	0
Totals	**$8,315**	**189**	**94**	**283**

Source: Land Economics Consultants analysis
[1] Assuming 50% of contractor costs go to labor, and mean annual wages are $44,000.
[2] Given an employment multiplier of 1.5, another half an FTE job is created in the 2-county region for every direct FTE job created.

The costs of Agency activities (e.g., conducting prescribed burns and surveying forests for survival rates) will support jobs within the Forest Service, but the conservative assumption is made here that none of these are net new jobs, but rather reflect Agency priorities and the allocation of time for people that would be on staff regardless. Given the regimen of prescribed burns, it would be advantageous to have more staff to conduct this ongoing activity.

Social Analysis

Same as Alternative 2.

CUMULATIVE EFFECTS

Same as Alternative 1.

Alternative 5

DIRECT AND INDIRECT EFFECTS

The prescribed treatments in Alternative 5 are very similar to those in Alternative 1, with the exception that the number and density of trees planted would be higher under Alternative 5. From an economic perspective, the large costs of equipment and manpower to remove fuels, prepare soils, release, and monitor progress dwarf the marginal costs of time and materials for planting additional trees to produce a higher initial density. In addition, because of the more complex planting design in alternatives 1, 3, and 4, the actual per acre cost of tree planting is likely to be less for Alternative 5 than it would be for those other alternatives. As a result, costs to the government and job creation are almost the same for alternatives 1 and 5.

Economic Efficiency

Following the same methodology as was used to analyze economic efficiency for Alternative 1 estimates for Alternative 5 are shown in Table 3.10-19. Agency costs for Alternative 5 are slightly less than what was shown for Alternative 1 because the costs of monitoring natural regeneration areas would not be required under Alternative 5. Contractor costs are slightly less under Alternative 5 due to less complicated planting. The total cost to the government to be incurred each year is presented in the fourth column. Using the appropriate discount rates, the PNC for Alternative 5 is calculated in the last column of Table 3.10-19. The total PNC of performing scheduled treatments under Alternative 5 over the next decade and a half is approximately $81 million.

Table 3.10-19 Alternative 5: Present Net Cost of Treatments to be Performed

Year	**Contractor Costs** (2015 $1,000s)	**Agency Costs** (2015 $1,000s)	**Total Costs**	**Discount Rate**[1]	**Discount Factor**[2]	**Present Net Cost** (PNC)
1	$732	$59	$790	0.00%	100.00%	$790
2	$3,832	$2,153	$5,985	0.05%	99.90%	$5,979
3	$8,168	$2,071	$10,239	0.10%	99.70%	$10,209
4	$8,741	$3,508	$12,249	0.25%	99.01%	$12,127
5	$9,694	$2,516	$12,211	0.40%	98.02%	$11,969
6	$9,637	$1,111	$10,749	0.55%	96.76%	$10,401
7	$8,341	$1,211	$9,552	0.70%	95.23%	$9,097
8	$6,182	$1,091	$7,273	0.77%	94.05%	$6,840
9	$3,867	$677	$4,544	0.83%	92.83%	$4,218
10	$3,392	$634	$4,025	0.90%	91.43%	$3,680
11	$1,968	$437	$2,405	0.93%	90.32%	$2,172
12	$2,127	$473	$2,600	0.96%	89.17%	$2,318
13	$159	$35	$195	0.99%	87.98%	$171
14	$696	$155	$850	1.02%	86.76%	$738
Totals	**$67,537**	**$16,131**	**$83,668**			**$80,711**

Source: Land Economics Consultants analysis

[1] Discount rates for federal analyses are presented in Appendix C of OMB Circular A-94 for key years, and discount rates for intervening years are estimated through linear interpolation.

[2] The Discount Factor is equal to $1/(1 + i)^t$ where i is the interest rate and t is the number of years from the date of initiation for the program or policy until the given future year.

Table 3.10-20 Alternative 5: Present Net Benefits Derived from Thinning or Harvesting Timber

Year	**Thin/Harvest** (acres)	**Estimated Yield** (board feet/acre)	**Produced** (MBF)	**Value Sold** (in $1,000s)	**Discount Rate**	**Discount Factor**	**Present Net Benefit** (PNB in $1,000s)
1	6	305	2	$0	0.00%	100.00%	$0
2	33	305	10	$1	0.05%	99.90%	$1
3	1,164	305	355	$36	0.10%	99.70%	$35
4	2,561	305	781	$78	0.25%	99.01%	$77
5	5,911	305	1,803	$180	0.40%	98.02%	$177
6	4,136	305	1,261	$126	0.55%	96.76%	$122
7	123	305	38	$4	0.70%	95.23%	$4
50	26,009	6,165	160,338	$13,570	1.40%	49.90%	$8,001
60	0	0	0	$0	1.40%	43.42%	$0
Totals	**39,943**	**8,300**	**331,515**	**$13,995**			**$8,417**

Source: Land Economics Consultants analysis

Table 3.10-20 shows the PNB for Alternative 5, which was calculated the same as the other alternatives. The PNV was also calculated the same as for the other alternatives. Given the PNB of

$8.4 million estimated above, less the PNC of negative $80.7 million, the PNV for Alternative 5 is negative $72.3 million. The larger the PNV, the more beneficial it is to the federal goal of economic efficiency. In the case of expensive action alternatives, the larger PNV would be the one that is "less negative."

Economic Impact

Table 3.10-21 Alternative 5: Jobs Created in Tuolumne and Mariposa Counties

Year	**Contractor Costs** (2015 $1,000s)	**Direct Jobs** (FTEs)[1]	**Indirect and Induced Jobs** (FTEs)[2]	**Total Jobs Supported** (FTEs)
1	$732	17	8	25
2	$3,832	87	44	131
3	$8,168	186	93	278
4	$8,741	199	99	298
5	$9,694	220	110	330
6	$9,637	219	110	329
7	$8,341	190	95	284
8	$6,182	141	70	211
9	$3,867	88	44	132
10	$3,392	77	39	116
11	$1,968	45	22	67
12	$2,127	48	24	73
13	$159	4	2	5
14	$696	16	8	24
Totals	**$67,537**	**1,535**	**767**	**2,302**

Source: Land Economics Consultants analysis
[1] Assuming 50% of contractor costs go to labor, and mean annual wages are $44,000.
[2] Given an employment multiplier of 1.5, another half an FTE job is created in the 2-county region for every direct FTE job created.

Economic impacts for Alternative 5 are similar to Alternative 1. Table 3.10-21 displays the applied consistent methodology to estimate direct, indirect and induced jobs created. Alternative 5 is estimated to support over 300 full-time-equivalent (FTE) jobs per year in the two-county area during periods of peak activity, totaling just over 2,300 throughout the treatment period. The burden on Forest Service staff time would be roughly similar to Alternative 1.

Social Analysis

Same as Alternative 1.

CUMULATIVE EFFECTS

Same as Alternative 1.

Summary of Effects Analysis across All Alternatives

Economic Efficiency

Economic efficiency focuses on the human economy and what can be quantified in dollar terms. It is a useful tool for federal decision making when choosing among alternatives, but it is limited in that it ignores substantial values that are not quantified in dollars, such as enhanced habitat quality, carbon sequestration, reduced risk of wildfires, and other ecosystem values. When comparing the economic efficiency of alternatives in Table 3.10-22, the only benefit shown is the value of forest products that generate revenue to the government as they are sold to private industry in future years. All of the action alternatives are expected to produce a little revenue from thinning activities over the next decade or so to help offset costs, and all alternatives, including the no action alternative, are expected to produce some merchantable timber for sale in 50 or 60 years. The end results differ significantly, however, and Alternatives 1 and 5 produce the highest PNB, three to four times as much as the other three alternatives, derived primarily from healthy timber sales in years 50 and 60.

Table 3.10-22 Summary of Economic Efficiency by Alternative

Discounted Values	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3	Alternative 4	Alternative 5
Present Net Benefit	$7,863,000	$1,871,000	$2,514,000	$2,288,000	$8,417,000
Present Net Costs	($82,997,000)	$0	($232,140,000)	($30,330,000)	($80,711,000)
Present Net Value	**($75,134,000)**	**$1,871,000**	**($229,626,000)**	**($28,042,000)**	**($72,294,000)**

Source: Land Economics Consultants analysis

Present Net Costs also vary significantly between alternatives, with Alternative 3 creating the most adverse situation for the federal government, due to the high cost of hand grubbing to replace the need for use of herbicides. At roughly one-third the cost of Alternative 3, alternatives 1 and 5 are essentially the same, and require approximately $80 to $83 million in expenditures over the next decade and a half to implement. Alternative 4 represents a low-cost alternative with only minimal human intervention in the forest's regeneration, most of which is in the form of prescribed fire. The no action alternative implies no costs of government actions, but that is a misleading indicator when the government recognizes that it is liable for costs of fire suppression and that Alternative 2 leaves more dead woody fuels and greatly increases government firefighting costs.

Present Net Value is the sum of properly discounted benefits and costs. By showing the highest value for this indicator, Alternative 2 suggests no action should be taken. When one includes the risk of uncontrolled fires and their costs, however, it can be seen that this is a false conclusion. Alternative 3 has by far the lowest value, and reflects the high costs of replacing herbicide use with manual labor. Among the other action alternatives, Alternative 4 creates the highest PNV in spite of having low benefits, because it is also low-cost. Alternatives 1 and 5 are essentially the same from an economic efficiency standpoint.

Economic Impact

With a focus on jobs created, the labor-intensive effort in Alternative 3 to produce the desired forest conditions without using herbicides generates by far the greatest number of jobs in Tuolumne and Mariposa Counties. Given the small size of the workforce devoted to forest work in the host counties, however, it is likely that the majority of the direct jobs supported would be taken by people who live outside the two counties, and who would be housed temporarily in Tuolumne and Mariposa motels while grubbing out the forest. During peak activity periods, this could put pressure on the motel inventory and distort revenue flows in other tourism supported businesses.

Alternatives 1 and 5 would require a more manageable demand on motel rooms, and would generate very similar levels of jobs. Alternatives 1 and 5 would likely be seen as equally beneficial by most participants in the local economy.

With minimal human intervention in the forest, Alternative 4 would also have a minimal beneficial impact on the economy. The no action alternative would be exactly that, and would generate no new jobs in Tuolumne or Mariposa counties. Table 3.10-23 summarizes jobs created by alternative.

Table 3.10-23 Summary of Jobs Created by Alternative (in FTEs)

Full-Time-Equivalent Jobs	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3	Alternative 4	Alternative 5
Direct Jobs Supported	1,579	0	5,176	189	1,535
Indirect & Induced Jobs	790	0	2,588	97	767
Total Jobs Supported	**2,369**	**0**	**7,764**	**283**	**2,302**

Source: Land Economics Consultants analysis

Social Analysis

In terms of the quality of life for residents of Tuolumne and Mariposa counties and their traditional social and cultural patterns, it is likely that most residents liked the conditions in the Rim Fire area as they were before the fire better than they are now. The action alternatives are designed to return the forest to similar conditions faster than the no action alternative. Due to their reliance on more active intervention, Alternatives 1, 3 and 5 would likely return pre-fire forest conditions faster than Alternative 4. Although not necessarily better or worse, the forest conditions under Alternative 4 would be "different" from prior conditions for decades to come, and resident opinions may vary as to the desirability of each outcome.

The perceived aesthetics of the forest (i.e., "beauty is in the eye of the beholder") and the recreational opportunities that are available within it would be a driver of tourism in Tuolumne and Mariposa counties. Visitation and recreation within the Rim Fire area will likely take place with or without the Forest Service taking action, or under any of the action alternatives, but the forms of recreation and the volumes of tourists may differ. Conditions that attract bird watchers may be different than those that attract fishermen and hunters. Conditions that maximize hiking may be different from those that maximize motorized trail activity. To the extent that return of a mixed conifer forest would have greater appeal to a wider range of traditional recreational pursuits and draw more tourists back to the forest, residents of the region who own businesses or work in the tourism industry would see some restoration of lifestyles that have been diminished by the reduced volumes of visitors by the Rim Fire.

Environmental Justice

Environmental Justice (EJ) is an executive order (EO 12898) which requires, in brief, that each Federal Agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low income populations. USDA Civil Rights policy requires each agency to analyze the civil rights impact(s) of policies, actions, or decisions that will affect federally conducted and federally assisted programs and activities. A civil rights impact analysis (CRIA) facilitates the identification of the effects of eligibility criteria, methods of administration, or other agency-imposed requirements that may adversely and disproportionately impact employees or program beneficiaries based on their membership in a protected group. Protected groups include multiples of similarly situated persons who may be distinguished by their common race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetics, political beliefs, or receipt of income from any public assistance program.

Actions including treatments to units within the Rim Fire area or deciding not to conduct any treatments and actions that are applied consistently to everyone are not discriminatory. Economically beneficial support for additional employment, generated by action alternatives, is not specific to any ethnic group or income segment of the population. No evidence suggests that considered actions (in their entirety) have disproportionately high and adverse impact on minority and low-income populations.

3.11 Soils

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

National Forest Management Act (NFMA) of 1976 as amended and the Forest and Rangeland Renewable Resources Planning Act of 1974) require the maintenance of productivity and protection of the land and, where appropriate, the improvement of the quality of soil and water resources. NFMA specifies that substantial and permanent impairment of productivity must be avoided.

Forest Service Manual (FSM) 2550 (USDA 2010c) establishes the management framework for sustaining soil quality and hydrologic function while providing goods and services outlined in the Forest Plan. Primary objectives of this framework are to inform managers of the effects of land management activities on soil quality and to determine if adjustments to activities and practices are necessary to sustain and restore soil quality. Soil quality analysis and monitoring processes are used to determine if soil quality conditions and objectives have been achieved.

Pacific Southwest Region (Region 5) FSM 2500 Chapter 2550 Supplement (USDA 2012a) establishes soil functions (support for plant growth (productivity) function, soil hydrologic function, and filtering and buffering function) that the Region uses to assess soil conditions and determine if the national soil quality objectives are being met. Each soil function has a set of indicators that frame the desired condition for soil resources. The analysis standards are used for areas dedicated to growing vegetation. They are not applied to lands with other dedicated uses, such as system roads and trails or developed campgrounds.

Forest Service Handbook (FSH) 2509.22, Chapter 10 (Water Quality Management Handbook) (USDA 2011b) improves and replaces the Best Management Practices (BMPs) presented in Water Quality Management for NFS lands in California. The Forest Service water quality protection program relies on implementation of prescribed BMPs. These BMPs are procedures and techniques that are incorporated in project actions and determined by the State of California to be the most effective, practicable means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals. Additionally, the 2011 Handbook amendment establishes an expanded water quality management monitoring program (section 16).

National Best Management Practices for Water Quality Management on National Forest System Lands (USDA 2012) that apply to the proposed activities are included in Chapter 2.

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

Soil effects are determined and predicted based on a review of relevant literature and from monitoring reports and observations of soils where similar actions have occurred in the past. While the physical actions may be similar, the impact to soils depends on the soil properties at that location, which can be highly variable. The analysis area for this report consists of soil that supports vegetation growth within the project area boundary. Soils under roads, trails, and recreation sites are not directly considered when addressing soil impacts from the project, but their indirect effects on soils supporting vegetation are considered where necessary (e.g. runoff from roads that leads to erosion in a treatment unit).

The soil effects analysis is bounded in time by the foreseeable future period during which detectable effects on the soil resource could persist in this project area. Some soil features, such as ground cover, can recover quite quickly. Effects on other features, such as compaction and soil organic matter, can persist for decades or centuries. Because soil effects can be persistent, the current soil conditions reflect the cumulative effects of past activities, regardless of when they took place. In general, effects are discussed as short-term (less than 5 years) or long-term effects (longer than 5 years). For cumulative effects, the analysis is bounded in time by past, present and reasonably foreseeable future projects.

Assumptions Specific to Soils

- Activities detailed in the Rim Recovery EIS (USDA 2014) are still in progress. However, for soil effects analysis, the baseline condition will assume that all activities in both the Rim Recovery and Rim Fire HT EA (USDA 2014h) projects have already taken place.
- All treatments prescribed under the natural regeneration units were assumed to be implemented in order to analyze for the most potential impacts.
- The condition of ground cover will be determined by currently proposed mechanical site preparation or prescribed burn treatments. In alternatives that contain units with only herbicide proposed for site preparation, past actions such as machine piling in combination with herbicide site preparation will determine future soil cover.
- Assumptions for Erosion Hazard Rating (EHR) analysis include:
  - All slopes are uniform and were generalized by soil type.
  - For EHRs, a single “climate” was used for the whole project area. The precipitation values were based on a weather station close to Corral Creek, near the middle of the Rim Fire.
  - Soil Cover inputs to the EHR analysis are estimates of percent ground cover that would be remaining after proposed treatment activities (e.g. site preparation) are complete. Estimated cover values were based on field surveys, ground cover data, and photographs of similar treatment types that have occurred on the Stanislaus in the past.
  - The EHRs include a factor to increase water infiltration for units that could receive deep till and forest cultivation (DTFC) treatments.

Data Sources

- Soil survey data including maps and soil properties from the Stanislaus National Forest Soil Survey (USDA 1981), and more detailed soil surveys covering portions of the project area (Norgren et al. 1990).
- Soil interpretations provided by the Region 5 Soil Interpretation Guide (USDA 1999).
- The Rim Fire Soil Burn Severity map and soils BAER report (Flores et al. 2013).
- Remote sensing data including the LiDAR DEM, and high resolution multi-spectral imagery acquired and processed in 2013 by the Forest Service Remote Sensing Lab based in McClellan, California.
- Geologic map of Tuolumne and Mariposa counties, and associated GIS layers.
- Soil pit descriptions, and additional field observations about soil disturbance and soil physical properties made by the soil scientist and field crews.

Soils Indicators

The Region 5 supplement (USDA 2012a) to the national soil management chapter provides direction for soil assessment procedures and defines the soil functions and indicators that were used to frame soil condition assessments. Three soil functions (environmental functions of soil) were used for assessment and analysis to determine if the national soil quality objectives were being met: support for plant growth function (soil productivity); soil hydrologic function; and filtering-buffering function. Each of these 3 functions has a set of indicators, listed below, that were used to determine if existing conditions meet the desired soil conditions in the project area. Full analysis of these indicators can be found in the Soils Report.

SOIL STABILITY

- Amount of unit with EHR higher than moderate
- Amount of soil cover removed by project activities

SURFACE AND SOIL ORGANIC MATTER

- Percent organic mulch cover remaining after site preparation (Criteria greater than 50% area covered)
- Area of productivity loss due to displacement of topsoil

SOIL STRENGTH AND STRUCTURE

- Area of productivity loss due to compaction or loss of soil porosity
- Area with reduced infiltration due to change in soil structure

SOIL MOISTURE REGIME

- Soil moisture regime in meadows and fens is retained

FILTERING BUFFERING FUNCTION

- Soil microorganism populations
- Leaching potential of applied herbicides
- Risk of off-site movement of applied herbicides

The indicators above include the following specific measures. Soil stability refers to a soil's ability to resist erosion. Soil cover protects a soil from water and wind erosion, and slope, vegetation type and infiltration rates all affect the overall risk of erosion. The EHR method incorporates all these factors to show relative differences in soil stability. To preserve soil stability, soil cover should be managed to avoid a high EHR (USDA 1999) after project activities are complete. For surface organic matter, an organic mulch consisting of duff and small woody debris should cover approximately 50% of the soil surface after site preparation, and 85% of soil organic matter should be preserved in the top 12 inches of soil (USDA 2010a). Soil porosity and soil structure should be maintained similar to the natural condition to maintain a favorable rooting environment for plants and to ensure sufficient infiltration rates to accommodate precipitation inputs (USDA 2012a). Soil moisture regimes should not be altered from their natural state, especially in wet meadows and fens (USDA 2012a). Lastly, no specific measures for soil filtering buffering function have been developed. Instead, the Region 5 Soil Management Handbook Amendment (USDA 2012a) states: for projects that involve the application of chemicals, such as herbicides, analyze the effects to soil micro-organisms, post-project erosion risk, leaching potential and risk of off-site movement of the chemicals.

Soils Methodology by Action

There are various types of activity groups proposed in this project that are performed with mechanical equipment or prescribed burning that have similar effects on soil: deer habitat enhancement, natural regeneration, reforestation (non-mechanical site preparation, plant conifers, prescribed fire, grubbing), and thin existing plantations. Tree thinning and prescribed burn actions for the purpose of deer habitat enhancement or for plantation thinning occur in different locations across the landscape, but have similar effects on soil; thus they were analyzed together in this section. Effects from mechanical site preparation, herbicide site preparation, and herbicide use for noxious weed eradication are all discussed separately.

SOIL DESCRIPTION AND INTERPRETATION

Soils information for this analysis was derived from the Stanislaus National Forest Soil Survey, the Natural Resources Conservation Service (NRCS) Soil Data Viewer (SDV), and from more detailed soil surveys covering portions of the project area (USDA 2008a; Norgren et al. 1990). The SDV was used to review distribution of specific soil properties potentially affected by mechanical equipment operations on a unit-by-unit basis. Specific interpretations and soil data properties from the SDV include soil texture, depth, rock content, soil taxonomy, infiltration and permeability, soil water holding capacity, soil composition within a unit, acceptable soil loss, slope percent, and soil productivity information such as soil survey site class or Net Primary Productivity. The analysis of these data was used, partly, to determine where various mechanical site preparation techniques would occur. The Soils Report includes a soil map.

SITE OBSERVATIONS

Field observations identified soil properties useful in confirming the accuracy of the soil survey, existing soil conditions, and soil response to management activities. Sampling in 2015 focused on important soil variables to determine how soils would respond to site preparation and herbicide treatments; variables sampled include soil depth, rock content, slope, surface rock outcrop, soil texture, ground cover, and soil hydrologic group. The predicted level of treatment impact, focusing on units with tractor piling and DTFC treatments first, was used to prioritize unit sampling. Twenty-five units proposed for DTFC treatments were visited and more than 250 plots and soil pits were recorded.

Additionally, site observations from 2013, acquired after the Rim Fire, supplemented the 2015 sampling. Because of ongoing salvage logging activities, some properties have changed since the sampling occurred (such as ground cover), and do not represent the existing condition; however, soil properties such as depth, hydrologic group, slope, texture, and rock content are still useful. Ninety-seven plots from 2013 were used.

Pre-harvest soil disturbance data were collected in areas covered by the Rim HT project using the protocol described by Page-Dumroese et al. (2009). Only limited data about soil disturbance after completion of the Hazard Tree project are available, including 11 transects. No soil disturbance data have been collected yet in the Rim Recovery salvage logged areas.

SOIL EROSION HAZARD RATING

The Region 5 Soil EHR System (USDA 1999) was used to rate the risk of erosion for all soils in the project area after implementation of project activities. This system uses various physical soil properties along with climate and site-specific conditions to rate sheet and rill erosion soil hazards. Inputs to the EHR system were adapted to best fit the predicted conditions after project activities were implemented. Soil cover inputs were derived from observed field data for Alternative 2. For action alternatives, monitoring data from similar past treatments was used to predict soil cover post-treatment.

LIDAR DATA ANALYSIS

A digital elevation model (DEM) derived from LiDAR data was used to create 1-meter slope layers, aspect and a hill shade layer that was used to visually inspect units for rock outcrops. These data were used in the unit-by-unit assessment of suitability for site preparation techniques, and as inputs to the EHR analysis.

Affected Environment

Soil Properties

The geology within the Rim Fire includes variable metamorphic rocks in foothill formations, volcanic mudflows and conglomerates on ridge locations, and young glaciated or old deeply-weathered granitic rocks throughout the area. Project area soils are primarily derived from metamorphic rock in the lower elevations and granitic rock at mid and higher elevations. Table 3.11-1 displays the general soil groups in the project area and the corresponding soil properties used in the analysis (Soils Report). Most soils within the analysis area have surface textures of loam or sandy loam with gravelly texture modifiers, and the most abundant soils have clay loam subsurface textures. This indicates soils with high natural infiltration rates at the surface, but only moderate permeability or ability to transmit water below ground. These soils range from shallow to deep, reflecting a wide range of soil productivity and soil hydrologic groups. Specific dominant soils include Holland, Josephine, Wintoner and Fiddletown. Rock outcrop is also common, even dominant, in several map units. Although rock outcrop does not produce sediment, it commonly produces runoff which accelerates erosion on soils downslope. The majority of soils (about 75%) within the proposed action have a severe compaction rating (high probability to be compacted by activities when moist). These tend to be the most productive soils in the project area, particularly the Holland and Josephine soils.

Table 3.11-1 Soil Families and Associated Properties Used in Analysis

Family	MAE (%)	T-FAC	Surface Texture	Subsurface Texture	DEPTH (inches)	COMP Hazard	ROCK (%)
Dystric Lithic Xerochrepts	2.00	1	Cobbly loam	Cobbly loam	20-40	Moderate	10-50
Dystric Xerochrepts	0.50	1	Cobbly loam	Coarse sandy loam	20-40	Moderate	0-25
Fiddletown	8.30	2	Gravelly to Bouldery sandy loam	Gravelly sandy loam	20-60	Slight	35-60
Gerle	4.00	4	Gravelly sandy loam	Sandy loam	40-60+	Slight	5-30
Holland	32.40	4	Loam	Clay loam	40-80+	Severe	5-20
Josephine	29.10	4	Gravelly loam	Clay loam	20-60+	Severe	10-30
Lithic Xerumbrepts	5.10	1	Loamy sand	Sandy loam	0-20	Slight	10-50
McCarthy	5.20	3	Gravelly sandy loam	Sandy loam	20-60	Slight	35-60
Pinole	0.40	4	Gravelly loam	Clay loam	60-80+	Severe	5-35
Rock Outcrop	0.28	1	Unweathered bedrock	NA	0-10	Slight	
Sites	4.54	2	Gravelly loam	Gravelly clay loam	20-80+	Severe	0-25
Typic Dystroxerepts	0.20						
Ultic Haploxeralfs	0.50	1	Sandy loam	Loam		Severe	0-10
Wintoner	7.60	4	Gravelly loam	Clay loam	40-60+	Severe	0-30
Xerolls	0.10	5	Loam	Loam	40-60+	Severe	0-15

COMP=Compaction; DEPTH=Soil Depth; MAE= Maximum Extent of Activities (% total acres); ROCK=Rock Content; T-FAC=T-Factor

Existing Conditions

The project area occurs entirely within the footprint of the 2013 Rim Fire. The soil burn severity within the Rim Fire was approximately 44% high and moderate soil burn severity, and the rest at low or very low burn severity. Immediately after the fire, the high and moderate burn severity areas had a deficiency of both soil cover and surface organic matter. Two years after the fire, substantial vegetation regrowth occurred in many locations, but the regrowth is variable. In some locations, native shrub species including some nitrogen-fixing species have produced significant ground and canopy cover. Some areas with high soil burn severity have less vegetation growth or have a cover of invasive species that are not providing the same protective soil cover. In short, recovery of vegetation is variable, leaving some locations vulnerable to erosion. The amount of soil organic matter lost in the fire has not recovered in two years, and any pre-fire soil disturbance causing compaction or displacement on major skid trails has not changed. In locations where no management actions have occurred in the last 2 years, the fire is still one of the dominant features controlling surface soil conditions. Existing conditions immediately post-fire were described in further detail in the Rim Recovery EIS, Chapter 3.11 (USDA 2014).

The Rim Fire hazard tree removal and salvage logging activities affected multiple soil indicators. The EHR method reflects changes made to soil cover and stability. Project-wide, EHR conditions range from low to moderate with 41% of the project area predicted to have a low EHR and 59% predicted to be moderate. This is an improvement in EHR conditions as described in the BAER report and Rim Recovery EIS. The improvement is primarily due to increases in ground cover since the fire. Data from 2014 soil disturbance monitoring at 11 Rim HT sites showed ground cover ranged from 62 to 87% with an average of 78%. Sampling in 2015 showed ground cover ranged from 35 to 85%, and averaged 60%. In short, ground cover within salvaged logged areas varies widely and is difficult to rate for the whole project, but it is currently sufficient in most areas to prevent a high EHR.

Results of soil disturbance monitoring reflect changes in other soil indicators including surface and soil organic matter (SOM), and soil strength and structure. In 2013, remote sensing analysis and field validation was done to identify legacy, or historic evidence of soil disturbance. While the skid trail footprint and levels of compaction have likely changed since 2013 due to salvage logging, the SOM lost due to displacement on those trails or combustion during the fire remains the same (in other words, the SOM has not recovered in 2 years). The most severe legacy compaction was found on benched skid trails or temporary roads on Josephine and Holland soils where clay subsoils were exposed and vegetation was stunted or non-existent. This reflects a reduction of soil porosity and displacement of the soil organic material. This, combined with SOM lost in combustion during the Rim Fire led to approximately 6,000 acres with reduced levels of SOM (USDA 2014 Soils Chapter 3.11). In 2014, sampling showed that 3 of the 11 units sampled, or 27%, exceeded disturbance thresholds and are expected to have a loss of soil productivity. Units typically exceeded thresholds as a result of excessive displacement and loss of SOM, or had excessive compaction. Sampling in 2015 showed that 9 out of 24 units sampled showed some sign of erosion evidence, and 7 units (or 29%) showed evidence of rill or gully erosion sufficient to have a loss of productivity.

Disturbance sampling in 2014 was only done in Rim HT project areas, and no data were collected in Rim Recovery salvage logged areas as methods for hazard tree removal are very similar to salvage logging. Although the sample sites were well-distributed throughout the project area, the sample size was small. The 2014 disturbance data are assumed to reasonably represent the conditions found in Rim Recovery treatment areas, but not enough data are available to rate the existing condition of soil indicators on a unit basis, or by activity groups. Instead, existing indicator ratings are provided below in Table 3.11-2 for the whole project area based on the best available data. More information about the predicted effects of Rim Recovery treatments can be found in the Rim Recovery EIS, Soils Chapter 3.11.

Table 3.11-2 Summary of Existing Condition of Indicators

Soil Function	Indicator	Rating Range	Metric[1]	Area
Soil Productivity and Hydrologic Function	Soil Stability	Good	EHR greater than moderate	0 units (0 acres)
Soil Productivity and Hydrologic Function	Soil Stability	Poor-Good	Presence of rill and gully erosion	7 units (29% of units)
Soil Productivity	Surface and Soil Organic Matter	Fair-Good	Percent ground cover, average project-wide	69%
Soil Productivity	Surface and Soil Organic Matter	Fair-Good	Percent of units sampled not meeting organic mulch cover requirement	17% of units
Soil Productivity	Soil Strength and Structure	Poor-Fair	Area with soil productivity loss due to compaction or displacement	27% of units
Soil Productivity	Soil Strength and Structure	Poor-Fair	Acres of productivity loss (legacy disturbance) post-fire	6,062 acres

[1] Rim Recovery EIS (3.11 Soils)

Environmental Consequences

Environmental consequences are discussed by the proposed treatment types. The action categories of deer habitat enhancement, natural regeneration, thin existing plantations, and reforestation in some cases use similar treatment types to achieve the objectives described, so discussions are grouped together by treatment type. As stated above, all treatments under the natural regeneration units were assumed to be implemented, so analysis related to all reforestation treatment types also applies to natural regeneration units. Discussions for each soil indicator include assessments for: mechanical and hand thinning of trees (including initial site preparation), prescribed fire (including pile burning), mechanical site preparation (machine pile, DTFC, etc.), manual release, and chemical site preparation and release. The act of conifer planting has minimal direct effects on all soil indicators, and is not discussed further. However, the density of planted trees and their contributions to soil moisture, cover and organic matter over time are important, and are discussed where appropriate. Noxious weed eradication treatments and chemical site preparation or release are discussed together.

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Soil Stability

In existing plantations proposed for tree thinning, soil cover would be reduced, especially on landings and main skid trails. In past monitoring of thinning-only treatments in a similar environmental setting, total soil cover typically remained high enough to meet forest standards and prevent a high EHR (Soils Report). In Alternative 1, most thinning units would also have prescribed understory burning implemented before thinning. Burning in combination with thinning would cause an initial reduction in soil cover due to organic horizon combustion. However, with typical spring or fall burning and associated high fuel moistures, this reduction would likely be within forest soil quality guidelines for cover. EHR analysis shows that in thin or thin and burn units, no areas would result in a high EHR.

A - Glyphosate release spray
B - Hand grubbing, only 2.5 foot radius
C - Dozer piling only
D - Dozer piling, followed by DTFC

Figure 3.11-1 Surface Organic Mulch after Different Treatments

Mechanical site preparation done with feller bunchers, mastication, or grapple piling would have effects similar to those of thinning alone, except most units would not have prescribed burning done first. Mastication treatments would increase soil cover through additions of shredded tree and shrub material. Burning of any piles created would reduce soil cover immediately under the piles, but the area would likely be small relative to the unit size. Mechanical site preparation could also be done with dozers or tractors with brush rakes used to push material into piles for burning. Dozer piling is not intended to reduce the fine fuels in contact with the ground, but because of “sweeping” of the surface by the larger targeted material, some surface cover would be displaced to piles. Recent and past monitoring of dozer piling shows that it can reduce soil cover well below forest standards in the short-term, making sites more susceptible to erosion, but the result is highly dependent on vegetation type and ground cover. In a recently monitored tractor piled unit, a young plantation burned in the Rim Fire, ground cover averaged only 36%. But two other units with a heavy component of manzanita (one burned, and one unburned) both had ground cover above 60% after treatment (Figure 3.11-1, C). EHR analysis shows only 6 units, or about 94 acres would be moved to a high EHR as a result of tractor piling.

The final mechanical site preparation method is deep tilling followed by forest cultivation. Monitoring of this treatment on the Stanislaus done in the 1990s and in 2015 show that ground cover is typically reduced considerably, sometimes below 20% (Soils Report). Cover is not typically moved off site, but is incorporated into below ground soil layers so it has less benefit to preventing erosion and stabilizing soil (Figure 3.11-1, D); this condition would remain until vegetation and planted trees produce ground cover sufficient to prevent erosion. Monitoring in 1993 (Soils Report) stated 62% of the sampled units showed “localized sheet and rill erosion characterized by gravel pavements, sediment basins, puddles and rill channels.” In this monitoring, the majority of the erosion occurred on soils with higher clay content. More rarely, severe rilling or gullying has been recorded on DTFC units, usually below road drainages that concentrate water onto loosened soil.

The monitoring of DTFC units in the 1990s recommended practices to limit or prevent erosion on this treatment, and many of these recommendations are included as management requirements in Alternative 1. Two soil types that most commonly showed severe erosion after DTFC treatments were Mariposa and Bandarita soils. In Alternative 1, these soils were avoided as much as possible when assigning DTFC as a site preparation treatment. On steeper slopes, the untilled vegetated buffer strips left below road drainage outlets and every 100 feet along the slope would provide material to capture and keep eroded soil on site and would help break up rill networks, if they were to form. With the soil management requirements, 116 units in Alternative 1 would have their EHR increased to high. This is a large increase in high EHR ratings compared to the existing condition and Alternative 2 (No Action), but compared to other action alternatives with DTFC treatments it represents the lowest number of high EHR ratings, and the lowest overall risk of erosion.

Herbicide applications targeting noxious weed species would create an initial pulse of ground cover as dead vegetation falls to the ground. While some of the noxious weed species provide ground cover for soil stabilization, they can also out-compete a diverse range of native vegetation that may produce better quality ground cover for soil stabilization. Less vegetative cover would be present 1 to 3 years after treatment, but if native species reestablish, the benefits for soil stability would outweigh the temporary reduction in vegetative cover. Manual pulling or grubbing weeds in Alternative 1 is expected to occur in small areas, having minimal effects on soil cover and stability.

Herbicide applications for site preparation and release have similar effects as noxious weed treatments, but on more acres. Leaves and woody material from treated shrubs and competing vegetation would die and fall to the ground within the first few years after treatment (Figure 3.11-1, A). In release treatments, this could occur in a large proportion of a unit. Ground cover is expected to increase initially, for 2 or 3 years after a site preparation treatment. During this time, a unit could receive additional release treatments, up to 3 times over a 5-year span. Release treatments would increase ground cover underneath targeted plants, similar to site preparation spray. Since the objective of release treatments is to control and reduce competition to planted trees, less vegetative cover would occur on a site with multiple release sprays. Overall, ground cover is expected to decrease somewhat between year 2 and year 10 after the initial herbicide treatment, and return to normal levels as planted trees drop needles and vegetation returns to the site. Total ground cover is difficult to predict in herbicide treated units, but in units not having tractor piling or DTFC treatments, it is expected to meet forest standards at all times through the final release treatment. In herbicide units without tractor piling or DTFC treatments, no areas are expected to have high EHR, and a majority of the units would have low EHR, and low expected erosion rates. When used in combination with mechanical site preparation treatments, ground cover conditions are determined by the mechanical methods with likely higher EHR values.

Surface and Soil Organic Matter

Surface organic matter refers to organic material on top of the mineral soil surface, including coarse woody debris (CWD), fine wood, and forest floor layers (O soil horizon). This material (especially finer sizes) is important for nutrient cycling and support of soil microorganisms. Soil organic matter (SOM) refers to organic matter that is a component of mineral soil horizons (mainly A horizons). In soils without high clay content, most nutrient exchange occurs in surface soil horizons where SOM is highest. Because of this, it is important to protect SOM, especially on soils with thin A horizons, such as Lithic Xerumbrepts and other shallow soils listed in Table 3.11-1.

Thinning units would generally have surface organic matter redistributed, but not moved off site. Where trees are felled and skidded, small limbs and needles are likely to break off, causing a moderate increase in fine woody debris. The O horizon would be displaced and mixed in areas where feller bunchers walk and on light skid trails. On heavy skid trails, surface organic matter would be buried and mixed in with surface soil horizons and would be scraped away close to landings. Displacement results in the removal of nutrient rich loamy material exposing the high clay content subsurface. This subsurface is deficient in soil nutrients, reduces infiltration, and has higher natural soil strength impeding root penetration. Fox et al. (1989) found displacement caused by windrowing decreased forest productivity. Displacement can also lead to channelized flow from entrainment between berms, reduced infiltration, and reduced surface roughness. Prescribed burning done before thinning would reduce surface organic matter through combustion, but relatively moist fuels in spring or fall burns should prevent large continuous losses of surface organic matter. This combination of activities would likely cause a reduction in, or possibly a neutral effect on, total nutrient pools in the forest floor. Many remaining nutrients, especially nitrogen, would mineralize or be released into mineral soil and would be more available to plants and soil biota (Moghaddas 2007; St. John 1976). Areas with high soil burn severity would result in a net loss of SOM as a result of combustion and volatilization of nutrients. This higher loss of SOM is more likely under pile burning, where fuels are concentrated and are expected to create enough heat to combust SOM immediately under piles.

Effects of mechanical site preparation done with feller bunchers or grapple piling would have effects similar to those described for thinning treatments. Mastication treatments would cause a direct increase in surface organic material. Masticated material acts as good soil cover, but in the short-term it does not have the same nutrient exchange properties as SOM or forest floor material. In the long-term as masticated material breaks down, it would provide nutrient exchange benefits. Site preparation with tractor piling could remove surface and SOM, as discussed above, via sweeping of topsoil into machine piles. Management requirements would limit the amount of soil that ends up in machine piles, protecting SOM, and the requirement for a brush rake should reduce the amount of surface organic matter that is removed. Depending on pre-piling site condition, soil cover (including surface organic matter) could still be reduced below 40%.

DTFC treatments mix surface soil layers, and can bring rocks or subsoil to the surface, especially in thin soils or those with higher clay content. This has effects similar to soil displacement when subsoil layers are brought to the surface. This displacement would occur unit-wide, except in buffer strips and untreatable areas such as rock outcrops. The forest cultivation treatment is designed to uproot and bring to the surface competing vegetation species, especially bearclover. This treatment would remove some surface organic material by mixing it into deeper soil layers, and would remove subsurface organic material such as roots by bringing them to the surface. When done in combination with tractor piling, large woody debris and fine woody debris would be almost completely removed from a site, with the exception of down log management requirements. Forest monitoring completed in 1993 showed all measured units failed to meet soil quality standards for small and large woody material (Soils Report). Management requirements retaining a buffer strip for every 100 feet of contour DTFC would mean a minimum of 8% of a unit would not receive DTFC, and should retain sufficient levels of surface and SOM. Outside these areas, surface organic mulch would remain below forest standards in the short-term, at least 2 years, until vegetation and planted trees produce sufficient surface organic material. The effect on SOM in the short-term would mean surface organics would be incorporated into the soil, and would increase organic carbon below ground. This result was shown in monitoring done on a Josephine soil on the Stanislaus where 3 of 4 sampled plots had a decrease in organic carbon at the soil surface (0 to 6 inches), and an increase of organic carbon in deeper soil layers (Soils Report). In the long-term (more than 5 years) it is unclear what would happen to SOM following DTFC. Mixing of soil may cause similar effects as soil displacement by exposing less productive subsoil layers, and increasing organic matter decomposition by increasing oxygen presence. Surface organics incorporated deeper into the soil may compensate for this loss somewhat, but overall SOM levels are predicted to decrease in the long-term. Visual inspections of DTFC units from the 1990s consistently display a lack of dark soil colors that are typically associated with high organic matter content in the A horizon, and often show noticeably slow organic matter decomposition at the surface, and little incorporation of new litter into the soil. However, no sampling has been done to show if levels of organic carbon are reduced in the long-term compared to units that did not have DTFC treatment.

Noxious weed eradication treatments would temporarily increase surface organic matter from dead vegetation accumulating on the soil surface, but are not expected to affect SOM levels. Herbicide site preparation treatments would also increase surface organic material in the short-term (Figure 3.11-1, A) as killed vegetation falls to the surface and decomposes. The effect to SOM in the long-term is unclear. Site preparation and release treatments would specifically target species like bearclover and deerbrush that have underground root networks that contribute to increases in SOM and fix nitrogen (deerbrush). These species would be reduced in herbicide treated areas for at least 5 years over the length of possible release treatments, but the rate they would recover is variable, and the long-term effect on SOM is unknown.

Soil Strength and Structure

Changes in soil porosity can affect water holding capacity, air and water movement, and the ability of roots to penetrate the soil (Alexander and Poff 1985; Williamson and Neilson 2000). A majority of actions are taking place on soils with a high compaction hazard (Table 3.11-1)

Soil compaction by mechanical equipment would reduce total porosity in thinning units. Feller bunchers are considered low ground-pressure equipment and are not expected to cause widespread compaction. Skidding operations, however, would detrimentally compact the soil. Williamson and Neilson (2000) found that most compaction occurs after 3 passes of log-laden equipment. Landings are areas of high compaction because they support skidding equipment, processors, and biomass trucks. The reduction of porosity would be greatest on landings and segments of main skid trails; however, compaction monitoring on the Stanislaus National Forest has shown that the footprint of the severely compacted areas is typically less than 15%, which meets the Forest standard (Soils Report). Additionally, smaller trees would be removed in existing plantation thinning, creating lower ground pressure and weight of skidding equipment compared to thinning larger trees and fewer passes along each skid trail would be needed.

Hand thinning and prescribed burn activities would have little to no effect on soil porosity or compaction. However, prescribed fire activities could alter soil structure at the surface of the soil. Organic matter can combust in surface layers of the A horizon (top 2 to 3 cm) if fire resides in one location long enough to heat soil to that depth. This could change the soil structure from granular to single-grain. However, with spring or fall burning and relatively high soil moisture content, this effect should be minimal compared to dry-season wildfires.

Effects of mechanical site preparation done with feller bunchers, mastication, or grapple piling would have effects similar to those described for thinning treatments. Slight reductions in soil porosity may occur, but should not reduce soil productivity. Tractor piling would cause similar levels of compaction when compared to thinning treatments, but the distribution would be different. Instead of compacted skid trails, compacted areas would be concentrated around machine piles where the dozer made multiple passes. However, if any of these thinning or site preparation treatments are followed by DTFC, the effects of compaction would be reduced. Deep tilling loosens soil and is often used as a treatment to alleviate compaction. The 1993 monitoring showed that 88% of DTFC units met the forest standard for maintaining porosity and preventing compaction (Soils Report). In coarse-textured soils, DTFC is not expected to drastically alter soil structure that is important for soil hydrologic function, and macroporosity levels would be maintained. In denser clay soils such as Sites and Josephine (Table 3.11-1), DTFC would increase macroporosity in the short term (1 to 3 years) by loosening dense clay subsoil, but after the soil settles, macroporosity may actually be reduced because of the destruction of soil structure, and the reduction in root channels and other large pores in clay soils. This alteration of coarse soil structure may be one of the factors that led to the increased erosion recorded in past monitoring (Soils Report). Infiltration is increased in the short-term because of soil loosening, but after about 3 years the benefits are lost as infiltration rates slow.

Noxious weed eradication and herbicide site preparation or release treatments are not expected to have a noticeable effect on soil strength, porosity, or soil structure because they do not require heavy equipment operation.

Soil Moisture Regime

Most proposed treatments (thinning, prescribed fire, noxious weed eradication, mechanical site preparation or herbicide site preparation and release) are unlikely to affect soil moisture regime on uplands. Where these treatments occur, soils don’t typically have a hydric, or moisture-dependent, soil moisture regime. Thus, these activities are not discussed for this soil indicator in any of the remaining alternatives.

Low density conifer planting around meadow perimeters and removing live trees around meadows would help maintain water-dependent moisture regimes in meadows by reducing water uptake by planted trees in the long-term.

DTFC treatments may alter the surface and subsurface water flow patterns within a unit by changing infiltration rates and water permeability, but the effect this would have on soil moisture regime is unknown. Increased infiltration for up to 3 years could reduce surface flow of water, or at least alter its course across a unit. Many water-dependent moisture regimes are influenced more by ground water than surface water.

Filtering Buffering Function

The only actions that could affect filtering-buffering function of soil are herbicide applications. The other treatments are not evaluated for this indicator.

Glyphosate is the only herbicide proposed for use in site preparation or in release treatments for the purposes of reforestation. According to the SERA report (2011), there is very little information suggesting glyphosate will be harmful to soil microorganisms under field conditions. Other research indicates that glyphosate can harm soil microorganisms under lab conditions, but it is likely to enhance or have no effect on soil microorganisms in field conditions or in soil (Busse et al. 2001; Wardle and Parkinson 1992). From examination of the effects of glyphosate on microorganisms in numerous forest soils throughout northern California, Busse (2001) failed to detect any changes in microbial population size, diversity, or function due to the herbicide applied at the field rate. When applied at concentrations well above the recommended rate, soil microbial growth was stimulated. Additionally, glyphosate does not appear to reduce the beneficial effect of mycorrhizal fungi (Busse 2001; Chakravarty and Chatarpaul 1990). Ratcliff et al. (2006) concluded that glyphosate has a benign effect on both soil bacterial and fungal community structure when applied at the recommended field rate to organisms in their native soil habitat.

The fate of herbicides in soil is determined by their chemical structure and reactivity or how they interact with the soil environment. Substances that are soluble in water and do not adsorb readily to soil particles or organic matter can leach through the soil. Such substances have the potential to reach water when precipitation amounts exceed the water infiltration rates of the soil. Substances that are adsorbed (roughly, bonded to) soil particles are mostly degraded in place and resist leaching. Adsorption of chemicals to soil particles depends primarily on soil clay and organic matter content, temperature, and pH.

Glyphosate tends to readily adsorb to soil particles, and is degraded by microbial action. This gives Glyphosate a relatively low mobility in soil, rarely penetrating below 12 inches depth. Its persistence in soil is typically less than 3 months and can be less depending on the soil conditions (SERA 2011). Past monitoring on the Groveland Ranger District has showed with typical application rates used for site preparation and release, glyphosate was not detected in soil after treatment (Soils Report).

Relatively little information is available on the toxicity of clopyralid to soil microorganisms. At concentrations of 10 parts per million (ppm) in soil, clopyralid had no effect on nitrification, nitrogen fixation, or degradation of carbonaceous material (SERA 2004). The USFS uses the 10 ppm value as a no observed effect concentration (NOEC) for soil microorganisms. Use rates for noxious weed eradication would be approximately 0.1 milligram clopyralid per kilogram of soil, which is far below the known value for potentially toxic levels for soil organisms.

Clopyralid is degraded primarily by microbes in soils and aquatic sediments. No metabolites accumulate during the degradation process and therefore, no additional contamination of the environment occurs (Pik et al. 1977). The half-life in soil can range from 10 days to 10 months, depending on soil temperature and moisture conditions (SERA 2004). The half-life for clopyralid is expected to be approximately 25 days for soils in areas treated for noxious weeds. Clopyralid does not bind tightly to soil particles; however, the potential for leaching or runoff is functionally reduced by the moderate degradation of clopyralid in soil. Recent monitoring on the Groveland Ranger District showed no evidence of clopyralid entering water after it was sprayed on noxious weeds adjacent to a stream (Peterson 2012a, 2012b).

The half-life of Aminopyralid in a field setting in soil can range from 25 to 74 days. Longer times of persistence (over 300) days have been observed in a laboratory setting where degradation of aminopyralid was the only means of dissipation (SERA 2007a). Soil invertebrates, including earthworms, appear to be relatively unaffected by aminopyralid and show no observable effects when exposed to 5,000 milligrams active ingredient per kilogram of soil (SERA 2007a). Similarly, soil microorganisms do not have adverse effects observed at concentrations up to 8 milligrams per kilogram of soil. In fact, the only observed effect was an increase in nitrate and total mineral nitrogen on the day aminopyralid was applied (SERA 2007a). Because of the application rates for this herbicide are very low, concentrations are expected to be well below the no effect concentrations given for soil microorganisms and invertebrates. Based on the persistence and toxicity information for Aminopyralid, it is not expected to cause any negative effects to soil microorganisms.

There are very little data available about the effect of clethodim on soil microorganisms, or other soil biota. The only terrestrial invertebrate that has toxicity information available is the honey bee, which has a No Observable Adverse Effect Level of 860 milligrams per kilogram of body weight. With normal application rates, it appears clethodim is unlikely to negatively affect bees and aquatic invertebrates (SERA 2014). Clethodim is not readily adsorbed by soil or organic matter particles, so, in a laboratory environment, it has been shown to be moderately mobile in soil. However, its expected half-life in a field environment is the shortest of any herbicide proposed for use in this project at only 3 days. With the proposed application methods and management requirements to limit timing of application there is a low probability that clethodim would be leached out of the soil profile or be moved off site through sediment losses because most of the substance it is likely to break down in a few days.

CUMULATIVE EFFECTS

Units that are proposed for DTFC site preparation would mitigate any compaction that resulted from Rim Recovery salvage logging treatments. This would be a beneficial effect, especially in units that were salvaged logged during the wet season.

There are several scenarios where the combined effect of past actions and currently proposed actions may create cumulative negative effects to the soil resource, or specific soil indicators. Those scenarios are where currently proposed actions overlap with: high soil burn severity from the Rim Fire, dozer piling proposed in the Rim Recovery, and in some cases salvage logging proposed in the Rim Recovery. Tractor piling that was proposed in the Rim Recovery would occur in many units with the same footprint as Rim Reforestation units. The combined effect of tractor piling and thinning or prescribed burning treatments in Reforestation would reduce ground cover sufficiently to create a high EHR condition. This would create a cumulative negative effect on soil stability and surface organic matter, and 1,260 acres would be moved to a high EHR category.

The combination of prescribed burning and thinning in existing plantations and deer habitat enhancement units is not likely to cause a cumulative negative effect in areas where the Rim Fire burned with low or moderate soil burn severity. However, where high soil burn severity occurred, there may be a cumulative negative effect to surface and soil organic material and total soil nutrient pools. The overlapping area of high burn severity and prescribed burning is smaller than the overlap with Recovery tractor piling which would have a more direct and predictable negative effect on surface and SOM.

Finally, locations with high soil burn severity in the Rim Fire, followed by salvage logging (excluding Watershed Sensitive Areas), followed by mechanical site preparation (especially dozer piling or DTFC) are the most susceptible to negative cumulative effects to soil resources. For EHR analysis, tractor piling treatments proposed in the Rim Recovery were used to determine the existing condition for ground cover, so the cumulative effect of that treatment would be captured. Areas with high soil burn severity that receive tractor piling treatments are the least likely to have sufficient surface organic matter to meet forest plan standards of 50% organic mulch after site preparation. It is expected that most of these areas will not meet forest plan standards after treatment.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

Soil Stability

Under Alternative 2, no project activities would occur, so there would be no direct effects on the soil resource. Other actions described under the Rim Recovery and other projects would continue. Because of the Rim Fire and Rim Recovery project activities, EHRs would be slightly elevated over their natural (unburned) condition, but no areas in the project area would have a high EHR. In most cases, soil cover for erosion protection would be limited to natural rates of accumulation, based on the vegetation types present post-fire. If there are locations that were under a forested vegetation type before the Rim Fire that are now chaparral vegetation, natural levels of ground cover could be reduced below their pre-fire condition. This could contribute to higher rates of erosion in the long-term (greater than 10 years), if forest vegetation is not re-established. This condition would mostly be expected in areas that are currently manzanita or chamise chaparral. Bearclover and other vegetation types that produce nearly 100 % ground cover would have similar erosion rates in the long-term as a forested site.

Noxious weed populations would remain and continue to displace native vegetation. In some cases, such as with non-native annual grasses, this could lead to a long-term reduction in soil stability. Native bunch grasses evolved under the area’s historic fire regime, and the soils that formed under these native species are a product of that long-term relationship. Non-native species may cause a long-term reduction in stability of soil, leading to a reduction in soil productivity.

Surface and Soil Organic Matter

The vegetation type and amount of vegetation recovery would determine the levels of surface organic matter that accumulate in the short-term under Alternative 2. Monitoring shows that units receiving dozer piling in the Rim Recovery may have reduced surface organic matter levels for several years until new vegetation restores ground cover and litter layers. In most parts of the project area, vegetation that has become established since the Rim Fire would dominate SOM processes. Soil cover would continually be added by litter accumulation, and nutrient cycling processes would be dominated by natural processes.

In existing plantations, no thinning or removal of standing small trees would occur; this material would fall over the next several years and accumulate fine and coarse woody material on the soil surface. In existing plantations that experienced high vegetation burn severity, fuel loadings in the next 5 to 10 years could reach levels that cause severe soil heating in a fire, if they were to re-burn (Brown et al. 2003). One study, in adjacent Yosemite National Park, examined the effects of multiple fires on vegetation in unlogged areas. Areas of high soil and vegetation burn severity were more likely to burn at high severity again in future fires (van Wagtendonk et al. 2012). However, areas that burned at low or moderate burn severity initially and had maintained forest conditions were more likely to burn at low or moderate burn severity in later fires. Fuel loading in contact with the soil surface is likely the most important variable in determining risk of fire damage to the soil during a possible reburn. Since a large part of the project area would be treated for fuel loadings in other projects, under Alternative 2 only unthinned plantations are at risk of fire damage to the soil.

Soil Strength and Structure

Existing levels of compaction under Alternative 2 would not be altered. Any existing compaction from legacy treatments or from Rim Recovery salvage logging would remain until natural processes restore soil porosity. Conversely, no additional compaction would be created from dozer piling, thinning, or other mechanical site preparation treatments.

Soil Moisture Regime

Thinning of live conifers around meadows would not occur under Alternative 2. In a few cases where there is conifer encroachment threatening the moisture regime, this could impact the meadow’s available water and moisture regime. In a majority of the project area, however, no actions would take place that affect soil moisture regime and existing conditions would continue to determine available water for soils in water-dependent systems.

Filtering Buffering Function

No herbicide applications would occur under Alternative 2. Soil microorganism populations would continue to cycle under normal post-fire conditions, and there would be no risk of herbicide substances leaching or movement within the project area.

CUMULATIVE EFFECTS

In the short-term, stabilizing vegetation that has grown since the Rim Fire would continue to expand and produce soil cover at natural rates and would not be altered by site preparation actions. Any existing compaction in DTFC areas would remain and slowly recover with natural processes. Erosion hazard would remain at moderate levels or below in all parts of the project area. In the long-term, in areas that transitioned from a forest-dominated to a chaparral-dominated environment, natural ground cover levels could be reduced and annual erosion rates could increase. To have a severe negative effect on soil productivity this vegetation type change and increased erosion rate would have to persist for a long period of time.

Alternative 3

Alternative 3 differs from Alternative 1 where changes affecting soils include: elimination of the use of herbicides, additional amounts of DTFC and hand grubbing. Management requirements affecting DTFC also differ from Alternative 1. Alternative 3 proposes additional DTFC site preparation treatments on 646 acres of proposed deer habitat enhancement areas, and on 3,809 acres of the proposed reforestation treatment areas. The additional areas of DTFC would be on sites proposed for herbicide site preparation in Alternative 1. The slope limitation for DTFC would increase to 35%, and untilled buffer strips on steep slopes (over 20%) or below roads would not be required.

DIRECT AND INDIRECT EFFECTS

Soil Stability

All thinning and pre-thinning prescribed burning would be the same as described in Alternative 1. Initial site preparation using prescribed burning or mechanical and hand treatments would also be the same as described in Alternative 1. The described effects, and the acres treated would be the same as Alternative 1.

The additional DTFC treatments would increase the risk of erosion on nearly all of the newly proposed acres. The removal of buffer strips and increase of suitable slope for this treatment increases the likelihood of concentrated water flow coming off of a road and initiating rill erosion, and would increase rill energy on slopes above 30%. Soil properties in each additional DTFC unit were reviewed by the soil scientist before being proposed for this treatment. In most of the additional units there are portions within them that had thin soils, steep slopes, or rock outcrops that would not be desirable to subsoil. Additionally, when units met criteria for slope steepness and rock content, some areas were proposed for DTFC on soil types that were said to be unfavorable for this treatment in past monitoring (Soils Report). This increases the risk of erosion compared to DTFC units in Alternative 1. As mentioned under Alternative 1, DTFC would increase macroporosity (and possibly infiltration) on dense clay soils in the short-term. With low intensity rainfall, this effect may prevent rill erosion from initiating in large areas in DTFC treatments, but in the event of large rainstorms with high intensity rainfall that exceeds infiltration rates, resulting in surface flow of water, the risk of rill or gully erosion rates goes up. The likelihood of large, intense rain events cannot be predicted, so there is not a guarantee of more erosion with additional DTFC acres, it simply increases the risk in the event of a large storm. The analysis predicts Alternative 3 would have the most number of units (170) and 22% of the total treated area with a high EHR. This is an increase of 54 additional units and 8% over Alternative 1.

In lieu of site preparation applications of herbicides, manual grubbing would be used after planting to remove competing vegetation. DTFC units would also receive hand grubbing as a release treatment. This action would remove soil cover and expose bare soil around planted trees (Figure 3.11-1, B). The area of a unit affected by grubbing would vary with the number of planted trees, and could range from approximately 45% to 89%. Compared to the herbicide site preparation in Alternative 1, manual grubbing would result in lower ground cover and a slightly elevated risk of erosion in the short-term.

Areas between planted trees would not be grubbed, leaving ground cover intact over the remainder of the unit. The additional grubbing has partly contributed to the increased acres of high EHR, but sprouting vegetation is expected to recover much more quickly than Alternative 1 in units that receive herbicide site preparation and release treatments. Thus, in hand grubbed areas the long-term effect of erosion could be increased or decreased compared to Alternative 1, and would be dependent on ground cover levels after the final release treatment is complete.

Noxious weed eradication would be done with one or more of the following methods: grubbing, hand pulling, prescribed fire, grazing and seeding with native species. Seeding with native species would increase ground cover and soil stability, a beneficial effect, as native plants are established. All other manual methods would reduce ground cover in some way. The Jawbone Lava Flat area contains the largest contiguous patch of noxious weeds and would have the most area that could have reduced ground cover. After treatment, the EHR within this unit would mostly be moderate, with some areas classified as low.

Although assumptions are factored into all modeling, the increased erosion risk and EHR is substantial enough to conclude that Alternative 3 would have the highest risk of reducing soil productivity as a result of erosion.

Surface and Soil Organic Matter

All thinning and pre-thinning prescribed burning would have the same effects as described in Alternative 1. Initial site preparation using prescribed burning, mechanical and hand equipment would also be the same as described in Alternative 1. The described effects, and the acres treated would be the same in Alternative 3 as in Alternative 1.

The additional DTFC treatments in Alternative 3 would have similar effects to surface and soil organic material as described in Alternative 1. Over the additional areas treated with DTFC, surface organic mulch would be reduced below forest standards in the short-term, subsurface organic carbon levels would slightly increase in the short-term and overall SOM levels are likely to decline in the long-term.

By not implementing buffer strips in Alternative 3, the amount of surface organic mulch would decrease further when compared to Alternative 1. In most DTFC units, small untreated areas, such as rock outcrops, would likely remain, leaving surface organic matter intact; however, no minimum amount of surface organic mulch is guaranteed to remain as refugia for normal nutrient cycling processes of forest floor layers. Displacement of SOM, as described in Alternative 1, would occur on the additional DTFC treated areas.

Alternative 3 manual noxious weed eradication treatments would reduce surface organic matter levels below what is described in Alternative 1, but the treatments are not expected to affect SOM levels. Similarly, hand grubbing for vegetation control after planting would displace and reduce surface organic mulch and SOM around planted trees. This would reduce the quality and quantity of organic mulch around trees until vegetation recovers and the trees grow large enough to produce litter. Shrub species such as bearclover and deerbrush are expected to recover more quickly than in Alternative 1, but the effect this would have on SOM levels is unknown. In areas without sprouting vegetation, grubbed sites would have reduced SOM levels compared to herbicide release units in Alternative 1.

Soil Strength and Structure

The effects to soil strength and structure in the Alternative 3 DTFC treatments would be the same as described in Alternative 1, but the effects would occur over larger areas. DTFC treatments would reduce compaction, where it exists, on the additional areas and buffer strips as stated in Alternative 1. Soil structure changes would be the same as described in Alternative 1.

Soil Moisture Regime

The meadow prescriptions and effects to soil moisture regime in meadows are the same as in Alternative 1. Alternative 3 includes a management requirement to avoid specific areas within the project that may be dependent on delivery of surface water to maintain soil moisture regime. As discussed for Alternative 1, the overall effect of DTFC on soil moisture regime is unknown, but avoiding areas with plants that are sensitive to changes in soil moisture would maintain the existing condition for water flow, and could potentially preserve the desired soil moisture conditions.

Filtering Buffering Function

No herbicide applications are proposed in Alternative 3, so the effects to soil filtering buffering function would be the same as described in Alternative 2 (No Action). Soil microorganism populations would continue to cycle under normal post-fire conditions without the risk of herbicide substances leaching or moving within the project area.

CUMULATIVE EFFECTS

The additional area of DTFC treatments would create more area at risk of negative cumulative effects to surface organic matter and soil stability, and the effects would be the same as described in Alternative 1. Similar to the cumulative effects described for DTFC, hand grubbing could create a cumulative negative effect to surface organic matter where it overlaps with Rim Fire high soil burn severity and Rim Recovery salvage logged areas. The combination of these past actions and hand grubbing, especially at the highest tree planting densities, could create a long-term deficit of surface organic mulch that would affect nutrient cycling around planted trees. A cumulative effect is less likely where high surface organic mulch cover or sprouting vegetation exists. Other cumulative effects, outside of DTFC and hand-grubbed areas would be the same as described under Alternative 1.

Alternative 4

The changes in Alternative 4 affecting soils, when compared to Alternative 1, include: eliminate DTFC treatments, reduce the number of reforestation units and acres of site preparation and release treatments, eliminate herbicide use for noxious weed treatments and add prescribed fire treatments. All thinning in deer habitat enhancement and existing plantations would have the same acres and effects for all soil indicators as described in Alternative 1. Noxious weed treatment acres and soil indicator effects would be the same as described in Alternative 3.

DIRECT AND INDIRECT EFFECTS

Soil Stability

Alternative 4 site preparation actions would occur over far fewer acres than in Alternative 1; no more than 20% of a unit area in Alternative 4 would receive mechanical or herbicide treatments. This means a larger area within reforestation unit boundaries would maintain existing soil cover for erosion protection. Where site preparation treatments do occur, they would be similar to those described for Alternative 1, but over fewer acres. Prescribed fire would occur in 50% of the reforestation areas and 50% of the complex early seral forest within the first 10 years. For EHR analysis, it was assumed that the whole unit footprint would receive prescribed fire, because the portions that would be burned are unknown at this time. Even with this over-assumption of treatment area, EHR ratings are reduced compared to Alternative 1. Approximately 2% of the area in Alternative 4, or portions of 12 units, would be elevated to a high EHR. This is a reduction in EHR rating compared to Alternative 1, but EHR levels would still be elevated above the existing condition.

Surface and Soil Organic Matter

The reduced area of dozer piling for site preparation treatments in Alternative 4 would ensure surface organic material remains intact over larger proportions of each unit treated, and compared to alternatives with DTFC treatments, surface organic mulch cover would be much higher. This means a larger area would have surface organic mulch available for nutrient cycling. The prescribed burning in reforested areas of Alternative 4 would have effects similar to those described in Alternative 1. Most complex early seral prescribed burning would occur outside the Alternative 1 treatment area, where surface fuel conditions could differ from most of the prescribed burn areas in Alternative 1. The location and timing of complex early seral prescribed fire is not well defined, so there is uncertainty about the level of effects to surface and SOM. Standing dead trees would fall at varying rates over the proposed timeline for prescribed burning, which would change surface fuel loading and how fire affects surface and SOM. However, all prescribed burning would need to retain more than 50% surface organic mulch cover to meet soil management requirements. Overall, surface organic mulch cover is expected to be sufficient in more areas, and SOM would be displaced over a smaller area compared to Alternative 1. In mechanical site preparation areas, improvements in these indicators would be proportional to the difference in acres treated between Alternatives 1 and 4.

Soil Strength and Structure

The nature of effects from mechanical site preparation and prescribed burning in Alternative 4 would be the same as described for Alternative 1, but would occur over a different area. The effects of mechanical site preparation would occur over a smaller area, and prescribed burning would occur outside unit boundaries described in Alternative 1. A major difference would be that DTFC treatments would not occur, so there would be no mitigation of compaction where it is created by thinning or site preparation activities.

Soil Moisture Regime

The Alternative 4 prescription for thinning of existing plantations around meadows is the same as in Alternative 1, so effects to soil moisture regime would be the same as Alternative 1. There is no specific planting prescription for meadows in Alternative 4, but the overall area planted is much smaller than in Alternative 1. Planting areas could be selected anywhere within the footprint of units; as long as planting does not occur next to meadows, then the effects to soil moisture regime in planted areas would also be the same as described in Alternative 1.

Filtering Buffering Function

Glyphosate is the only herbicide proposed for use in Alternative 4, as no herbicides are proposed to treat noxious weeds. Where it is applied, glyphosate, used only for reforestation treatments, would have similar effects to soil microorganisms as described in Alternative 1. A low risk of off-site movement or leaching of glyphosate could occur, as similarly described in Alternative 1, but the potential affected area would be smaller.

CUMULATIVE EFFECTS

The reduced area of site preparation treatments would reduce the area of negative cumulative soil effects to surface and SOM and to soil stability in Alternative 4. The reduced area of cumulative effects is partly captured in the EHR analysis because Rim Recovery tractor piling was considered when assigning ground cover values. Only 12 units showed high EHR values, a large reduction compared to Alternative 1. Areas of overlap with Rim Fire high soil burn severity are not directly captured in the EHR analysis, but again, the area of overlap between these areas and Alternative 4 treatments would be smaller than in Alternative 1, leading to less area with potential cumulative negative soil effects.

Alternative 5

DIRECT AND INDIRECT EFFECTS

The changes in Alternative 5 affecting soils, when compared to Alternative 1, include: thin new plantations (replacing post-planting prescribed fire with tree thinning) and increase the slope limit for DTFC to 35%. Alternative 5 replaces the natural regeneration treatments found in Alternative 1 with reforestation treatments. In Alternative 1, natural regeneration treatments would be monitored first, before implementing reforestation actions, so there is no guarantee reforestation actions would take place if they are not needed. However, in the effects analysis for Alternative 1, all natural regeneration units were assumed to receive all proposed reforestation actions, to analyze for the most potential impacts. In reality, the total treated area in Alternative 1 could be smaller than Alternative 5, even though the effects described are very similar. In short, Alternative 5 would have the largest "guaranteed" footprint of proposed activities.

Soil Stability

The proposed hand thinning after planting in Alternative 5 would, by itself, have little or no impact to soil cover and stability; however, burning the piled cut material would reduce ground cover underneath the piles and the effects would be similar to those described for pile burning in Alternative 1.If the material is lopped and scattered instead, it would provide additional ground cover for erosion protection. The increased slope limit for DTFC treatments would lead to slightly more acres within a unit being treated; small pieces of a unit that would have been excluded from DTFC treatment in Alternative 1 would be treated in Alternative 5. This would slightly increase the risk of rill and gully erosion over the whole unit. If rill erosion initiates, it would have slightly more erosive power on slopes above 30%. The EHR tool is a relatively coarse model, and does not capture this small difference in proposed treatments. Thus, EHRs are the same in both Alternative 1 and Alternative 5 with 116 units and 14% of the treated area in a High EHR.

Surface and Soil Organic Matter

The additional area treated with DTFC in Alternative 5 would remove surface organic mulch causing a slight reduction in overall mulch cover in each treated unit with steeper slopes. All DTFC units are expected to be deficient in surface organic mulch. So, while the larger area of removal is a negative effect, it would not change the overall unit rating. SOM would be affected by displacement in the same area.

Soil Strength and Structure

Thinning new plantations in Alternative 5 would only be done by hand, so no additional compaction is expected when compared to Alternative 1. The additional pile burning would affect soil structure underneath piles as described in Alternative 1. The additional loss of soil structure under burned piles would be of relatively small extent, because only small trees (less than 10 years old) would be burned. If the material is lopped and scattered instead, it would not negatively affect soil structure. Compared to Alternative 1, no additional negative effects to soil hydrologic function are expected from this treatment.

Soil Moisture Regime

The application of a 25-foot buffer around all meadows adjacent to reforestation units in Alternative 5 and thinning new plantations to have minimal tree structure adjacent to meadows may lead to slightly higher tree densities around meadows than Alternative 1, but the intent is similar. In the long-term, this would help maintain water-dependent moisture regimes in meadows by reducing water uptake by planted trees, similar to Alternative 1.

Filtering Buffering Function

With the stated assumption that natural regeneration units in Alternative 1 would be analyzed for all reforestation activities, then Alternative 5 has the same proposed herbicide use, and the same effects to soil filtering buffering function as Alternative 1. The "guaranteed" area impacted by herbicide treatments would be larger in Alternative 5, but the effects would be the same as in Alternative 1.

CUMULATIVE EFFECTS

Same as Alternative 1.

Summary of Effects Analysis across All Alternatives

Table 3.11-3 provides a summary of the EHRs across all alternatives, a quantitative prediction of soil stability after treatment for each alternative. The effects on other soil indicators are qualitative summarizations of the previous effects analysis.

Soil Stability

Alternative 3 creates the highest risk of soil erosion, and reduces ground cover below forest standards over the largest area, because of additional DTFC units, large areas of hand grubbing and fewer soil management requirements. Alternative 5 has a slightly elevated risk of erosion over Alternative 1, but less than Alternative 3. Alternative 4 would leave the most soil cover overall in the project area, but treated areas would have the same level of erosion risk as Alternative 1, and erosion risk with Alternative 4 is higher than Alternative 2.

Surface and Soil Organic Matter

Alternative 3 creates the largest area with surface organic mulch below forest standards, due to additional DTFC units and hand grubbing. Alternative 4 would leave the highest percent surface organic mulch on soil surfaces, and would have the lowest impact to SOM. Alternative 5 would have slightly less surface organic mulch than Alternative 1 in added DTFC areas, but more mulch cover elsewhere because of the removal of post-planting prescribed fire.

Soil Strength and Structure

Alternative 3 would have the largest benefit to soil strength by reducing compaction in added DTFC units. Levels of compaction would be similar between Alternatives 1 and 5. Alternative 4 would have the most legacy compaction persisting because of a lack of DTFC treatments; however, it would also create the least amount of compaction because of the smallest mechanical treatment footprint. Alternative 3 would alter soil structure over the largest area, but severity of effects on soil structure are mixed, with improvement in the short-term, but a loss in structure and reduced infiltration after year 3 over the largest area.

Soil Moisture Regime

Effects between all action alternatives are relatively similar, and would provide a slight improvement in soil moisture regime in meadows that are water-dependent.

Filtering Buffering Function

Alternative 3 would have the lowest probability for off-site movement of herbicides, with no leaching of herbicide substances, and effects to soil microorganisms closest to Alternative 2. Alternative 4 has the lowest probability of off-site movement or leaching of herbicides due to glyphosate's high adsorption and relatively low mobility in soil. Alternatives 1 and 5 would have the same risk of off-site movement and leaching, due to the inclusion of more soil-mobile herbicides. All alternatives with herbicide treatments would have similar effects to soil microorganisms; evidence suggests none of the herbicides proposed would have strong negative impacts to soil organisms.

Table 3.11-3 Comparison of Alternatives: Summary of Erosion Hazard Rating (EHR)

Indicators[1]	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
High EHR	14%	0%	22%	2%	14%
Moderate EHR	70%	59%	63%	89%	70%
Low EHR	16%	41%	15%	9%	16%
Total units with area exceeding high EHR	116	0	170	12	116

[1] Percent of alternative area

3.12 Special Areas

This section describes the affected environment and the environmental consequences for Special Areas. For the purposes of this project, Special Areas are Forest Plan management area land allocations within or adjacent to the Rim Fire perimeter that include: Special Interest Areas (SIAs); Wild and Scenic Rivers and Proposed Wild and Scenic Rivers (Wild and Scenic Rivers); and, Wilderness (USDA 2010a).

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

Special Interest Areas

Three SIAs are located within the Rim Fire perimeter: Bourland Creek Trestle Historic Area; Pacific Madrone Botanic Area; and, Jawbone Falls Heritage Area. The Rim Reforestation project does not include treatment units within or adjacent to the Bourland Creek Trestle SIA; therefore, that SIA is excluded from further analysis. Forest Plan direction for SIAs is to protect values, make educational opportunities available and preserve the integrity of the special interest feature for which the areas were established (USDA 2010a, p. 129). Special cutting methods will be used to salvage mortality or improve the quality of resources other than the timber resource (p. 133).

Wild and Scenic Rivers

The **Wild and Scenic Rivers Act** (82 Stat. 906, as amended; (16 U.S.C. 1271-1287) establishes the National Wild and Scenic River System and establishes policy for managing designated rivers. Under the Act, designated rivers “shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations” (16 USC 1271). Section 10(a) states: each component of the national wild and scenic rivers system shall be administered in such manner as to protect and enhance[7] the values which caused it to be included in said system without, insofar as is consistent therewith, limiting other uses that do not substantially interfere with public use and enjoyment of these values. Section 12(a) states: particular attention shall be given to scheduled timber harvesting, road construction, and similar activities which might be contrary to the purposes of this Act.

FSH 1909.12, Chapter 8 includes direction to manage selected river corridors to preserve their notable values or features as part of, or for eventual inclusion in, the National Wild and Scenic River System.

Forest Plan direction for Wild and Scenic Rivers is to protect and enhance Proposed Wild and Scenic River characteristics and manage the same as designated Wild and Scenic Rivers (USDA 2010a, p. 117). Designated and proposed Wild and Scenic Rivers, along with immediate environments, will be managed to preserve their free flowing condition and protect their outstandingly remarkable values (p. 111). The Forest Plan allocates Wild classification river segments to Primitive or Semi-Primitive Non-Motorized ROS; and, Scenic and Recreational classification river segments to Roaded Natural ROS (p. 114). Special cutting methods will be used to improve the quality of Wild and Scenic River resources (p. 116).

The **Tuolumne Wild and Scenic River Plan** (USDA 1988a) provides additional direction for that congressionally designated river. Timber management objectives include the following:

- Manage vegetation to protect and enhance Wild and Scenic River values, placing special emphasis on protecting streamside vegetation.

[1] The Interagency Wild and Scenic Rivers Coordinating Council interprets Protect as elimination of adverse impacts and Enhance as improvement in conditions (IWSRCC 2002)

Wilderness

The **Wilderness Act of 1964** (Public Law 88-577) and the 132 subsequent laws designating Wilderness contain numerous statutory provisions addressing management of Wilderness. It establishes a National Wilderness Preservation System of federal lands where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain.

Several sections of FSM 2320 provide management direction for Wilderness:

- Wilderness values shall dominate over all other considerations except where limited by the Wilderness Act, subsequent legislation, or regulations (FSM 2320.3).
- Do not maintain buffer strips of undeveloped wild land to provide an informal extension of Wilderness. Do not maintain internal buffer zones that degrade Wilderness values (FSM 2320.5).
- Manage each Wilderness as a total unit and coordinate management direction when they cross other administrative boundaries (FSM 2320.5).
- Where a choice must be made between Wilderness values and visitor or any other activity, preserving the Wilderness resource is the overriding activity (FSM 2320.6).
- Display the relationship and coordination between the Wilderness and activities present in the Wilderness, as well as activities outside of the Wilderness that affect the management of Wilderness (FSM 2322.03).
- Protect air quality and related values, including visibility, on Wilderness land designated class I by the Clean Air Act as amended in 1977 (FSM 2323.61).

Forest Plan direction for Wilderness is to: maximize the quality and naturalness of the Wilderness environment; minimize impacts to the Wilderness resource while allowing it to be used for primitive recreation and preserving scenic, scientific, educational and historical values; all NFS lands within Congressionally designated Wilderness and areas recommended for Wilderness will be managed in accordance with the Wilderness Act of 1964 (16 USC 1131-1136) as amended (USDA 2010a).

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

Assumptions Specific to Special Areas

SPECIAL INTEREST AREAS

- Site preparation and reforestation in the Pacific Madrone SIA would be conducted in such a way that project activities would not damage the integrity of the unique botanical features, the madrone trees, including seedlings and saplings that are coming up post fire.
- Site preparation including deep tilling, forest cultivation, mastication (shredding) and machine piling and burning will occur outside of cultural resource boundaries thereby having no adverse effect to cultural resources within the SIA.
- Use of existing breaches within linear sites such as historic railroad grades, trails, and will cause no adverse effect the SIA.
- Hand or direct localized application of herbicides to noxious weeds within cultural resource site boundaries are not anticipated to have any adverse effects on cultural values, particularly plant species important to California Indian Basketweavers or other Native American gatherers within the SIA.
- Removal of smaller diameter non-commercial timber (biomass) and standing dead trees within and adjacent to cultural resources through limited mechanical and hand cutting methods will have no adverse effect to cultural resources.

- All slash, brush and other vegetation removed from within and outside of cultural resource site boundaries will be piled and burned outside of site boundaries thereby having no adverse effect to cultural resources.
- Use of existing and development of new water sources are not anticipated to affect the SIA.

WILD AND SCENIC RIVERS

- No treatment actions will occur in Wild and Scenic Rivers or proposed Wild and Scenic River corridors.
- Proposed treatments would not affect the free-flowing condition of any Wild and Scenic River.
- About 98% of the Rim Fire burned within the Tuolumne River watershed.
- All proposed treatments are several miles from the main fork of the Merced Wild and Scenic River corridor and none are visible from anywhere along the river.
- The remaining 2% of the Rim Fire burned in the North Fork Merced River watershed along the southern edge of the fire. The North Fork Merced is a main tributary to the Merced Wild and Scenic River. All proposed treatments are several miles from the Merced Wild and Scenic River corridor and none are visible from anywhere along the river. The limited amount of treatments in the North Fork Merced watershed will not affect the Merced Wild and Scenic River.

WILDERNESS

- For the purposes of this project, the generic term Wilderness includes the Emigrant Wilderness and the Yosemite Wilderness.
- No treatment actions will occur in designated Wilderness.
- Action alternatives will not cause long-term changes to Wilderness character, recreation opportunities or access.

Data Sources

SPECIAL INTEREST AREAS

- GIS shapefiles with the location of the Pacific Madrone SIA.
- GIS Layers of the Stanislaus National Forest Basemap 2014.
- 2009 GIS Ortho Photo layers.
- Existing information from consultation with Indian Tribes, cultural resource records, historic archives, maps, and GIS spatial layers were used.

WILD AND SCENIC RIVERS

- Stanislaus National Forest GIS library
- Stanislaus National Forest: Forest Plan Wild and Scenic River Study (USDA 1991a)
- Tuolumne Wild and Scenic River Plan (USDA 1988a)
- Project GIS maps

WILDERNESS

- Stanislaus National Forest GIS Library
- National Visitor Use Monitoring (NVUM) data (USDA 2014c)
- Project GIS maps

Special Areas Indicators

SPECIAL INTEREST AREAS

- SIA values are specific to each SIA and may include unique botanic, cultural, geologic, scenic, historic and memorial features. Pacific Madrone Botanic Area has unique botanic features and the Jawbone Falls Heritage Area has unique cultural features.

WILD AND SCENIC RIVERS

- **Wild and Scenic River Values**: For a river to be eligible for Wild and Scenic River designation it must be free-flowing and, with its adjacent land area, must possess one or more outstandingly remarkable values (47 Federal Register 173, September 7, 1982; p. 39454-39461). ORVs are specific to each river segment and may include cultural, ecologic, fish, geologic, historic, scenic, recreation, wildlife or other. Table 3.12-1 shows the specific ORVs for the segments within the Rim Reforestation project.

Table 3.12-1 Outstandingly Remarkable Values and River Classifications for Wild and Scenic Rivers

River/Stream	Segment	Miles	SCEN ORV	RECR ORV	GEOL ORV	FISH ORV	WDLF ORV	H/CR ORV	OTHR ORV	WILD CLASS	SCEN CLASS	REC CLASS
Tuolumne	Yosemite - Early Intake	5	SCEN	RECR	GEOL		WDLF	H/CR	S/E W	5		
Tuolumne	Early Intake - Cherry Creek	1		RECR			WDLF	H/CR	S/E			1
Tuolumne	Cherry Creek - Lumsden	4	SCEN	RECR	GEOL	FISH	WDLF	H/CR	S/E	4		
Tuolumne	Lumsden Area	4	SCEN	RECR	GEOL	FISH	WDLF	H/CR	S/E		4	
Tuolumne	Lumsden - Terminus	15	SCEN	RECR	GEOL	FISH	WDLF	H/CR	S/E W	15		
	Total Designated	**29**								**24**	**4**	**1**
Clavey	1 Bell Creek	7	SCEN					H/CR	ECOL	6	1	
Clavey	2 Lily Creek	11							ECOL	9	2	
Clavey	3 Bell/Lily - 3N01	5				FISH			ECOL		5	
Clavey	4 3N01 - Cottonwood Road	8				FISH	WDLF		ECOL	4	4	
Clavey	5 Cottonwood Road - Tuolumne	16	SCEN	RECR		FISH	WDLF		ECOL	14	2	
SF Tuolumne	2 MF Tuolumne - Tuolumne	2	SCEN						OTHR		2	
	Total Proposed	**49**								**33**	**16**	**0**
	Total	**78**								**57**	**20**	**1**

CLASS=Classification; FISH=Fish; ECOL= Ecologic; GEOL=Geologic; H/CR=Historic/Cultural; ORV=Outstandingly Remarkable Value; SCEN=Scenic; REC=Recreational; RECR=Recreation; S/E=Scientific/Educational; WDLF=Wildlife; WILD=Wild

WILDERNESS

- **Wilderness Character**: the degree to which the untrammeled, natural, undeveloped, and opportunities for solitude or primitive and unconfined recreation qualities of Wilderness are diminished.

Special Areas Methodology by Action

SPECIAL INTEREST AREAS

- **Pacific Madrone Botanic Area**: A field visit revealed that Pacific madrone trees in the SIA survived the Rim Fire. Analysis of effects to Pacific madrone trees from activities proposed in the Rim Reforestation project utilized existing data acquired primarily through past site monitoring and anecdotal information from botanists from other Forests.
- **Jawbone Falls Heritage Area**: Utilizing previous archaeological inventories from past projects that meet current survey standards (1986 to present) nearly 78% of the proposed treatment areas were eliminated from further inventory. A strategy was developed to intensively survey (50 to 100-foot interval spacing) the remaining treatment areas. The strategy is consistent with the Regional PA 2013 and the Rim PA 2014 (project record).

WILD AND SCENIC RIVERS

- The geographic extent of this analysis for direct and indirect effects is river corridor boundary, one quarter-mile on either side of the high water mark of the rivers.
- The analysis for cumulative effects includes those effects within the river corridor and, given that nearly the entire project area drains to these rivers, cumulative effects of this project occur at the

watershed scale. 3.15 Watershed displays potential cumulative watershed effects (e.g., sedimentation and other impacts to water quality).

- The analysis of each alternative considers whether the activities would alter ORVs of the associated river segments. The short-term timeframe for this analysis is three to five years.
- The long-term timeframe for this analysis is ten years.
- The temporal bounds of the analysis are generally dependent on the lasting effects of project activities. Short-term effects are impacts from project activities that are expected to last up to 5 years. These would include disturbances associated with implementation of the proposed activities as well as impacts that would endure beyond implementation, up to 5 years. Long-term effects are those projected to endure beyond 5 years.

WILDERNESS

- The geographic extent of this analysis is the area of the Wilderness that falls within 0.5 mile of project activities. Rim Reforestation project activities would occur on NFS land adjacent to the Wilderness. No project activities are planned in the Wilderness.
- The temporal bounds of the analysis are generally dependent on the lasting effects of project activities. Short-term effects are impacts from project activities that are expected to last up to 5 years. These would include disturbances associated with implementation of the proposed activities as well as impacts that would endure beyond implementation, up to five years. Long-term effects are those projected to endure beyond 5 years.

Special Interest Areas: Affected Environment

Existing Conditions

JAWBONE FALLS HERITAGE AREA

The Jawbone Falls SIA was established in 2000. Consisting of 47 acres, the area was identified by the Tuolumne Band of Me-Wuk Indians as sacred and one of the most significant traditional cultural properties of the Central Sierra Me-Wuk people. At the time it was established, significant cultural values were identified through field surveys and consultation with Indian Tribes and other interested parties. The specific nature of the cultural resources is administratively confidential, under the provisions of the Archaeological Resource Protection Act of 1974, as amended (43 CFR 7).

From the onset of the Rim Fire incident and continuing through the Rim Recovery and Rim Reforestation projects, the Forest Archaeologist consulted with the Tuolumne Band of Me-Wuk Indians regarding protection of traditional collection areas and sites significant to the Miwok people. Native peoples continue to utilize the Jawbone Falls SIA area for traditional gathering and will continue to do so.

Historic records, maps and oral accounts encompassing the Jawbone Falls SIA boundary indicate moderate land use since the 1880s in the form of ranching/cattle grazing and railroad logging. Earliest records indicate a number of homesteads were patented near the area of Jawbone Falls mainly for acquiring title to valuable timber. However, as noted in the 1920 Stanislaus Land Classification Atlas, although timber “will be removed in time”, grazing would continue to be “the chief industry for some time to come.” Some of the existing trail/road system is likely connected to moving livestock to summer pasturage. Associated features affected by the fire include, fences, wooden troughs and collapsed wooden structures (range cabins).

The West Side Lumber Company founded in 1899 did not reach the area of the SIA until the 1940s. As the company expanded to its easternmost timber tracts during this time period, timber in and around Jawbone Falls was harvested. Associated features affected by the Rim Fire event include railroad grades, cut and fill structures, donkey sets and associated equipment.

PACIFIC MADRONE BOTANIC AREA

The Pacific Madrone SIA consists of two small groves of Pacific madrone trees covering 15 acres. These are located along Road 1S13C in Packard Canyon and about 5 acres overlap a reforestation unit. The management emphasis of this SIA is to protect and manage the unique botanical features for which it was designated, namely the southern-most groves of Pacific madrone in the Sierra Nevada. Resource activities such as fuels reduction and reforestation are allowed within the SIA provided the integrity of the SIA is protected (USDA 2010a). In recent years, discovery of young Pacific madrone trees and saplings outside of the SIA indicates madrone trees have been successfully reproducing and expanding their distribution in the vicinity.

The Pacific Madrone SIA occurs within an area which had not burned for more than 100 years. In the past, timber harvest occurred in the SIA, but more recently management activities have not taken place. As a result, the understory became overgrown with regenerating conifers. The habitat within the SIA tends to be comparatively cool and damp owing to the northeast aspect and position in the bottom of a perennial stream drainage. Madrone trees in the SIA survived the Rim Fire likely due to the microclimate of the site. Additionally, it is possible fire burned through this area at night when fire activity was lower. Madrone trees outside the SIA did not fare as well; most reportedly sustained canopy mortality. Pacific madrone is known to resprout from the root crown after fire so many trees with canopy mortality will likely survive.

Special Interest Areas: Environmental Consequences

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Jawbone Falls Heritage Area

Under Alternative 1, the potential direct and indirect effects to the Jawbone Falls SIA are minimal as proposed treatments within the SIA would be limited to small diameter non-commercial timber (biomass) and hazard trees approved by the Tribe that would enhance or protect those cultural values that make the SIA significant and unique.

Additionally, Alternative 1 includes extensive use of herbicides within a variety of proposed treatments (i.e. reforestation site preparation, noxious weed eradication, and deer habitat enhancement). In all treatment areas application of herbicides would be accomplished through the use of backpack sprayers for direct localized application. In cases where noxious weeds are within cultural resource site boundaries the use of herbicides will only be allowed as long as it does not affect plant species important to California Indian Basketweavers or other Native American gatherers or cultural values contained within the SIA. In each case a Forest heritage specialist will be consulted prior to treatment within sites.

Cultural resource sites located within the boundaries of the SIA will be delineated with coded flagging and/or other effective marking i.e. “flag and avoid” for protection prior to project implementation as stipulated in the Program of Rim Fire Emergency Recovery Undertakings, Tuolumne County, California Programmatic Agreement (Rim PA, project record).

Pacific Madrone Botanic Area

The existing madrone trees, saplings, and seedlings would be avoided during all implementation and no planting would be done adjacent to these trees. Forest Plan direction is to protect and promote these trees within this SIA. Reforestation work would only be done where activities could avoid these trees, and each tree or seedling would have a 25-foot no-planting buffer. Providing forest canopy would benefit the madrones in the long-term as providing adjacent forest would contribute to the cooler climate madrones thrive in. Additionally, establishing a conifer forest would minimize brush fields that would carry fire more readily. Therefore, minimal, to no, direct or indirect effects would occur to the Pacific Madrone SIA.

CUMULATIVE EFFECTS

Jawbone Falls Heritage Area

All projects listed in Cumulative Effects Analysis (Appendix B) have been or will be subject to NHPA Section 106 compliance and potential effects to cultural resources would be identified at that time following stipulations in the Rim PA (project record).

Alternative 1, when combined with the past, present and foreseeable future actions and events, shown in Appendix B, is not expected to cumulatively lead to increased impacts to the cultural values or cultural resources that make Jawbone Falls an SIA.

Pacific Madrone Botanic Area

The direct and indirect effects of Alternative 1 are minimal and would not degrade the integrity of this SIA. Appendix B shows no other present or foreseeable future projects are planned for the SIA location. With minimal to no direct or indirect effects to the Pacific Madrone SIA and no foreseeable future actions, no cumulative effects occur under Alternative 1.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

Jawbone Falls Heritage Area

Alternative 2 has no direct effects; however, this alternative may have indirect effects to the cultural values and resources through inaction. The existing threat of fire-weakened non-commercial and smaller diameter trees falling naturally, and potentially damaging already fragile cultural resources, would continue. The actions presented in Alternatives 1, 3, 4 and 5 would further remove dense vegetation, biomass and hazard trees preventing damage to archaeological resources and therefore reduce the potential for ground disturbance to sites and associated cultural values within the SIA.

Pacific Madrone Botanic Area

Alternative 2 has no direct effects; indirect effects may occur in untreated areas where falling dead trees damage madrone trees and saplings, or kill madrone seedlings. Once the trees fall they could block germinating madrone seeds, cause excess ground level shading for madrone seedlings and create high fuel accumulations, which could burn at high intensity causing madrone crown mortality and possibly killing madrone trees, saplings or seedlings. Non-reforested areas would initially come back to brush fields and be more susceptible to fire in the short-term and not provide forest canopy for shade and cooling in the long-term.

CUMULATIVE EFFECTS

Jawbone Falls Heritage Area

This alternative, when combined with the past, present and foreseeable future actions are expected to cumulatively lead to a minimal increase of impacts to cultural values and resources. As stated above, Alternative 2 may have an indirect effect to these values where lack of treatments within and around cultural resource sites may increase the potential for ground disturbance and damage to site features and cultural values contained within the SIA.

Pacific Madrone Botanic Area

Alternative 2 poses indirect effects to this SIA. Appendix B shows no other present or foreseeable future projects are planned for the SIA location. With indirect effects to the Pacific Madrone SIA and no foreseeable future actions, the indirect effects described under Alternative 2 are the cumulative effects of Alternative 2.

Alternative 3

DIRECT AND INDIRECT EFFECTS

Jawbone Falls Heritage Area

The potential effects in Alternative 3 are similar to Alternative 1. As in Alternative 1, the potential direct and indirect effects to the Jawbone Falls SIA are minimal as proposed treatments within the SIA would be limited to those small diameter non-commercial timber (biomass) and hazard trees approved by the Tribe that would enhance or protect those cultural values that make the SIA significant and unique. Unlike Alternative 1, ground disturbing activity would substantially increase in Alternative 3 due to the absence of herbicide treatments. Increased ground disturbance through deep tilling, forest cultivation and hand grubbing, increases the chance to uncover previously unknown cultural resources where deposits are largely subsurface. As with any project, should heritage properties be located during implementation, activities will cease in the area and the District Archaeologist or designated individual will be notified immediately, which would lessen the likelihood of additional damage.

Pacific Madrone Botanic Area

Same as Alternative 1.

CUMULATIVE EFFECTS

Jawbone Falls Heritage Area

All projects listed in Appendix B are subject to NHPA Section 106 compliance and potential effects to cultural resources would be identified at that time following stipulations in the Rim PA.

Alternative 3, when combined with the past, present and reasonably foreseeable future actions and events are not expected to cumulatively lead to increased impacts to cultural resources.

Alternative 3 would continue the restoration efforts started with the Rim Recovery project. The reforestation plan would lessen the effects of future wildfire on these sites, protect fragile resources and return the ecological setting or appearance to the time of the Native American presence, thus preserving those values that would make these sites significant and allow for future studies.

Pacific Madrone Botanic Area

Same as Alternative 1.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Same as Alternative 1.

CUMULATIVE EFFECTS

Same as Alternative 1.

Alternative 5

DIRECT AND INDIRECT EFFECTS

Same as Alternative 1.

CUMULATIVE EFFECTS

Same as Alternative 1.

Wild and Scenic Rivers: Affected Environment

One congressionally designated and two proposed Wild and Scenic Rivers lie within the Rim Fire perimeter. This includes all 29 miles of the designated Tuolumne Wild and Scenic River on NFS lands; the lower half of the Clavey Proposed Wild and Scenic River (24 miles); and, all of the South Fork Tuolumne Proposed Wild and Scenic River (2 miles).

About 98% of the Rim Fire burned within the Tuolumne River watershed. The remaining 2% burned in the North Fork Merced River watershed along the southern edge of the fire. Table 3.12-2 displays the river segments affected by the Rim Fire.

Table 3.12-2 Wild and Scenic River Corridors Affected by the Rim Fire

Wild and Scenic River	Classification	Segments	Total Miles[1]	Miles within Project Area	Total Acres[1]	Acres within Project Area
Clavey River	Wild	3	33.0	16.2	10,560	4,822
	Scenic	3	14.0	7.3	4,480	2,377
Tuolumne River	Wild	3	24.0	21.5	7,680	6,050
	Scenic	1	4.7	4.7	1,381	1,381
	Recreational	1	1.0	0.6	320	96
South Fork Tuolumne River	Scenic	1	2.5	2.5	681	681

[1] Within NFS lands

Clavey Proposed Wild and Scenic River

The Clavey Proposed Wild and Scenic River includes 33 miles of Wild and 14 miles of Scenic segments, including its tributaries Bell Creek and Lily Creek. It was proposed for its free-flowing characteristics, abundance and quality of life zones and vegetation, elevation range, and relative remoteness and lack of development. The Rim Fire affected half (23.5 miles) of the 47 mile river corridor: 7.3 miles of Scenic classification and 16.2 miles of Wild classification are within the analysis area. The 5 miles of Wild segments within Wilderness were not affected by the Rim Fire. The primary ORVs of the Clavey River inside the Rim Fire perimeter include ecological, fish, scenic, wildlife, and recreation (USDA 1991a, p. 46-50) as described below.

ECOLOGICAL

The Clavey River (including Bell and Lily Creeks) has a combination of landscape ecology features making it distinct within the Sierra Nevada Mountains: 1) free-flowing characteristics; 2) abundance and quality of life zones and vegetation; 3) elevation range; and, 4) relative remoteness and lack of development.

The Clavey River is one of the longest remaining free-flowing streams in the Sierra Nevada. It is 47 miles from source to mouth, including both headwater forks, Bell and Lily Creeks. Free-flowing condition is an important value because little remains in the Sierra Nevada. From the Feather River on the north to the Kern River on the south, all but one (the Consumnes) of the 15 major rivers in the Sierra, are impounded. Of 90 major tributaries, only four streams greater than 40 miles are free-flowing with no impoundments or diversions from headwaters to mouth. The Clavey River contains all but one Sierra Nevada life zone within its watershed. Elevation ranges from 1,200 feet at its mouth to 9,200 feet at its headwaters, allowing for all life zones except true alpine. At its headwaters, sub-alpine forests of red fir, lodgepole, western white pine and mountain hemlock combine with mountain meadows and granite-bound lakes. All forest habitats are found as elevation decreases, ending with the California chaparral type at the mouth of the river. Within the wide variety of high to low elevation vegetative types in the Clavey, one is truly unique: Bell Meadow, at 6,500 feet along Bell Creek, contains the largest stand of quaking aspen (110 acres) in the southern half of the Sierra.

Another feature of the Clavey River is its minimal development. It is almost entirely under federal ownership; even the portions outside of Wilderness are relatively undisturbed and remote. Private lands and developments such as towns and roads line portions of most other rivers in the Sierra. The Clavey, although crossed by several roads, has remained relatively undisturbed because of its remoteness, rugged nature and its north-south geographic orientation. For much of its length, the Clavey runs perpendicular to the east-west trend of major roadways in its watershed.

FISH

The Clavey was one of the first streams in California to be designated as a Wild Trout Stream, representing a mid to low elevation trout stream in a remote location. It is also now designated as a state Heritage Trout Water (Watershed Report).

Wild Trout streams provide self-sustaining trout fisheries which are not supplemented by hatchery stocking. It is believed that almost the entire basin contains only fish native to this portion of the Sierra Nevada. About 95% of the basin has an original fish assemblage. Rainbow trout is the only trout species in the basin (Lily Creek is reported to have some non-native brook trout and non-native brown trout may spawn at the confluence with the Tuolumne River). Rainbow trout are found in all of the Clavey and its tributaries capable of supporting coldwater fish.

The lower portion of the Clavey also contains a native assemblage of warm water fish including Sacramento suckers, Sacramento squawfish and hardhead. Due to extensive planting of non-native trout species and the illegal introductions of non-native warm water fish species, few other streams in the Sierra contain the original assemblage of fish species. The Clavey River may be the only "rainbow trout" river left, in the Sierra Nevada, with its original fish assemblage still intact and relatively unaffected by introduced species.

SCENIC

Outstanding Variety Class A landscape includes a deep, V-shaped, river-cut canyon through metasedimentary rock. The river provides a variety of water forms including rapids, cascades and pools. Vegetation patterns are varied, including scattered ponderosa pine and oak-grass woodland. The scenic values of the lower Clavey are similar to those of the lower Tuolumne Wild and Scenic River.

WILDLIFE

The intensity of the Rim Fire changed the structure and type of vegetation in the WSR corridor, which has likely changed wildlife presence there. Prior to the fire, fisher and spotted owl habitat existed within or adjacent to the northern portion of the WSR corridor, but much of it was burned in the Rim Fire and is no longer suitable. Peregrine falcon habitat, due to the rugged limestone cliffs, exists in the lower portion. Goshawk territories were present along the WSR corridor prior to the Rim Fire.

RECREATION

Hiking and fishing are the popular dispersed activities. Access is limited and portions are remote and wild, resulting in a rare opportunity for solitude and non-motorized recreation experiences, below the snow and available all year.

This portion of the Clavey has been traversed by expert kayakers. It is a native trout fishery, and a State designated Wild Trout Stream which is significant to anglers. Hiking and swimming are the popular activities near the Clavey confluence with the Tuolumne Wild and Scenic River.

The Rim Fire burned with varying intensity along the one-half mile wide river corridor, consuming vegetation with a basal area loss of less than 50% in 17 miles of the corridor, and a basal area loss of greater than 50% in the other 12 miles. Loss of vegetation has seriously altered the Scenic ORV of the river corridor and resulted in reduced visual diversity and wildlife habitat.

South Fork Tuolumne Proposed Wild and Scenic River

The South Fork Tuolumne Proposed Wild and Scenic River, located in the south-central portion of the Forest, includes the 2 mile Scenic segment from the Middle Fork Tuolumne River to the Tuolumne River. ORVs include scenic quality and other. There are no water-related ORVs for the South Fork (USDA 1991a, p. 51).

SCENIC

Outstanding Variety Class A landscape includes a deep, rugged canyon. The river provides a variety of water forms including rapids, cascades, waterfalls, and pools. Rim of the World Vista, located above the river area on Highway 120 (Big Oak Flat route to Yosemite National Park), provides outstanding scenic views of the deep river canyon, all the way to its confluence with the Tuolumne Wild and Scenic River.

OTHER

"Other" areas are considered sensitive because they are fragile or nonrenewable. About 65% of the viewshed in the one-half mile wide river corridor is affected with a basal area loss of over 75% due to the Rim Fire. The remaining 35% of the river corridor viewshed sustained 25 to 75% basal area loss. Some randomly scattered and small (less than 1 acre) patches of less than 25% basal area loss exist along the corridor. Loss of vegetation severely compromised the scenic ORV for this river.

One electricity transmission line crosses over the river corridor and an aqueduct (tunnel) crosses under and parallel to the river corridor. Two un-numbered roads totaling about one-half mile access the transmission line in the river corridor.

Tuolumne Wild and Scenic River

The Stanislaus National Forest portion of the Tuolumne Wild and Scenic River includes 24 miles of Wild, 4 miles of Scenic, and 1 mile of Recreational segments. The river is located in the south-central part of the Forest. ORVs include fish, geologic, historic and cultural, recreation, scenic, scientific and educational, whitewater boating and Wilderness characteristics. These ORVs were listed in the 1979 Tuolumne River Study EIS (USDA 1979). The study took place prior to the more detailed ORV descriptions that are used now for this type of assessment. However, the study described the reason behind choosing these ORVs as diverse habitat, several vegetation zones, steep-walled canyons, a significant variety of fisheries, remoteness, recreation opportunities, one of the finest whitewater boating opportunities in the nation, and many prehistoric and historic sites, including Miwok sites and evidence of gold rush history.

Lumsden Road (1N10) runs 5.9 miles along the south and west sides of the river within the scenic corridor, crossing once at the Lumsden Bridge. Routes off the Lumsden road within the river corridor include the 0.1 mile 1S52, 0.1 mile 1N10A, and 0.2 mile 1N10E. Two hiking trails, 17E40 and 17E56, run parallel to the river on the south side and are in a Wild classification segment of the river. One trailhead, one put-in for boating, 3 camping sites, and one gaging station are the only facilities within the Scenic segment of the river. Dispersed camping associated with boating occurs along the river west of Merals Pool.

The Rim Fire burned with varying intensity along the one-half mile wide river corridor, mostly consuming vegetation greater than 50% of the basal area. Because of steep canyon walls, an estimated 10 to15 miles has a view from the river corridor where over 75% of the vegetation has been consumed. This is at both the west end of the river and the easterly end of the river. In areas where the corridor is flatter, about 19 miles have basal area consumption of 0 to 50%. Loss of vegetation has seriously compromised the Scenic ORV of the river corridor, reduced visual diversity and wildlife habitat, and created an increased risk of soil erosion within the steep slopes of the canyon.

The Tuolumne Wild and Scenic River was divided into eight segments for planning purposes, with boundaries between segments based on the types and levels of existing development, access, recreation opportunity, and the potential for classification as a unit separate from adjacent segments. Table 3.12-3 shows the eight segments, their length and classification.

Table 3.12-3 Tuolumne Wild and Scenic River Classifications

Segment	Classification	Length (miles)
Yosemite to Early Intake	Wild	5
Early Intake to Cherry Creek	Recreational	1
Cherry Creek to Lumsden Area	Wild	4
Lumsden Area	Scenic	4
Lumsden Area to Clavey River	Wild	4
Clavey River to Indian Creek	Wild	3
Indian Creek to Mohican Mine	Wild	6
Mohican Mine to Terminus	Wild	2
Total		**29**

RECREATION USE (ALL RIVERS)

Hiking and fishing are popular dispersed activities in all three river corridors. Access is limited due to topography and lack of roads. Rainbow Pool, just upstream of Highway 120, is a popular picnic and swimming area for day use visitors and the City of Berkeley Family Camp located upstream. The pool was also the location of an historic stagecoach stop and former resort. Whitewater boating (rafting and kayaking) is popular on the Tuolumne River. Expert kayakers have floated the Clavey.

At the confluence of the Tuolumne and South Fork are the popular Lumsden and South Fork campgrounds, which are accessed via the visually bracing and not-for-the-driving-challenged Lumsden Road. This area is also the put-in for the world famous class IV whitewater run on the Tuolumne. The Rim of World Vista on Highway 120 provides outstanding views of the precipitous drop of the South Fork all the way down to the main stem of the Tuolumne.

Wild and Scenic Rivers: Environmental Consequences

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Clavey Proposed Wild and Scenic River

Proposed actions adjacent to the proposed Wild and Scenic River boundary include a variety of treatments, including thinning existing plantations, understory burning, and reforestation. The vast majority of treatments near the Wild and Scenic River corridor are reforestation units. None of the ORVs are expected to be permanently affected by the proposed treatments, although smoke from burning could linger over the area for several days, potentially affecting Scenery in the short-term. Scenic ORVs would improve over time as the reforested trees grow and add diversity to the landscape. The Wildlife ORV would be indirectly enhanced due to the beneficial effects of activities that target deer habitat enhancement, although the treatments would occur outside of the Wild and Scenic River corridor.

Though treatments would not occur within the corridor, there could be slight indirect impacts to aquatic biota in tributaries of the proposed Wild and Scenic River due to sedimentation and herbicide use, thus affecting the Fish ORV. Due to the spatial distribution of project units, measurable impacts in the Clavey River would likely be minimal; tributaries in those watersheds are more likely to be measurably affected

The other ORVs, Ecological and Recreation, would not be affected. The free flowing characteristic of the river would be maintained. Where project activities are proposed within sight distance of the proposed Wild and Scenic River, distance and geographic features would obscure most treatments from the casual observer or users of those areas.

South Fork Tuolumne Proposed Wild and Scenic River

Two treatment units are proposed immediately adjacent to the south of the proposed Wild and Scenic River boundary. The two units, a reforestation and a reforestation and thinning unit near Rim of the World and Colfax Spring, are located well above the river. Additional units proposed for thinning are located near the high point of the boundary to the south. As these are located well above the river and outside the boundary, impacts are not expected to occur to the scenic ORV of this river. Where project activities are proposed within sight distance of the proposed Wild and Scenic River, distance and geographic features would obscure most treatments from the casual observer or users of those areas. Scenic ORVs would improve over time as the reforested trees grow and add diversity to the landscape.

Tuolumne Wild and Scenic River

No treatment units are proposed immediately adjacent to the Wild and Scenic River boundary. A cluster of units are located to the south, approximately half a mile from the southern boundary and to the north of Highway 120. These units are proposed for reforestation and thinning. Due to their location, the ORVs of geologic, historic and cultural, recreation, scenic, scientific and educational, whitewater boating and Wilderness characteristics would not be affected. Due to the spatial distribution of project units, measurable impacts in the Tuolumne to the fish ORV would likely be minimal. Tributaries in those watersheds are more likely to be measurably affected.

CUMULATIVE EFFECTS

Ongoing or recent past actions within Wild and Scenic River corridors include salvage harvest, road maintenance and removal of hazard trees. Vegetation management is proposed to occur along powerlines in the Tuolumne Wild and Scenic River corridor. The scenic quality of the Clavey has been degraded due to the fire intensity in that area and temporary drift smoke from burning could contribute to short-term degradation of the scenery ORV in site specific areas. However, effects from drift smoke would be minor and not long-lasting. No cumulative effects are expected to the other ORVs of the designated or proposed Wild and Scenic Rivers.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

Since no actions are proposed, Alternative 2 would not affect ORVs for any of the proposed or designated Wild and Scenic Rivers.

CUMULATIVE EFFECTS

There are no direct or indirect effects, so there are no cumulative effects.

Alternative 3

DIRECT AND INDIRECT EFFECTS

Same as Alternative 1.

CUMULATIVE EFFECTS

Same as Alternative 1.

Alternative 4

Direct and Indirect Effects

Clavey Proposed Wild and Scenic River

The units adjacent to the proposed Wild and Scenic River boundary are composed mainly of early seral forest treatment units. The presence of smoke from burning could temporarily affect scenery in these locations, but would not permanently alter this ORV. Only 50% of the complex early seral forest units would be burned within a moderately long fire return interval (10 years), so effects would be minor. No long-term effects are expected.

A few natural regeneration units and potential founder stand planting units are proposed to the east of the proposed Wild and Scenic River corridor. Site preparation and plant and release treatments could be used in the natural regeneration units if results are not achieved in five years. Proposed founder stands are small in nature. These units are outside of the proposed Wild and Scenic River boundary and treatments would not affect scenery.

The other ORVs for this proposed Wild and Scenic River are not expected to be affected by treatment actions (refer to 3.15 Watershed for effects to tributaries). Although early seral forest exists within the corridor, no treatments to these units are proposed during the life of this project.

South Fork Tuolumne Proposed Wild and Scenic River

Less than ten treatment units are located near or adjacent to the proposed Wild and Scenic River boundary, and are composed of early seral forest treatment units. The ORV of scenery could be temporarily affected by smoke but would not permanently alter this ORV. Only 50% of the complex early seral forest units would be burned within a moderately long fire return interval (10 years), so effects would be minor. No long-term effects are expected.

Tuolumne Wild and Scenic River

Treatment units adjacent to the Wild and Scenic River are early seral forest units. Effects to the scenery ORV are similar to the Clavey Proposed Wild and Scenic River. The ORVs of geologic, historic and cultural, recreation, scientific and educational, whitewater boating, fish and Wilderness characteristics would not be affected.

Cumulative Effects

Effects to scenery due to smoke would be similar to Alternative 1, but less since there are few units located adjacent to WSR boundaries, and because the fire interval would be so long in nature. There would be no cumulative effects to the other ORVs.

Alternative 5

Direct and Indirect Effects

Effects to scenery on all designated and proposed WSRs due to smoke would be similar to Alternative 1, although since fire would only be used in existing plantations, smoke would be less than in the other action alternatives. The differences in spacing prescriptions would not affect the ORVs.

Cumulative Effects

Same as Alternative 1.

Wilderness: Affected Environment

The Emigrant Wilderness is located in Tuolumne County. It is characterized by large expanses of bare, glaciated granite and sub-alpine vegetation types, numerous glacial lakes, high quality scenery and Wilderness recreation opportunities. It is bordered on the east by Toiyabe National Forest and

Yosemite National Park. The Emigrant Wilderness became part of the National Wilderness Preservation System in 1975. The California Wilderness Act of 1984 added 5,855 acres to the original area, bringing it to its current size of 113,000 acres. Most of the recreation use in the Emigrant Wilderness Area is for hiking, camping, backpacking, and horse-back riding; pack-stock are also commonly used. Fishing is popular at most lakes, but hunting use is light.

Commercial livestock grazing occurs in some areas. Tungsten mining in the Snow Lake area has occurred in the past. Portions of several streams which are eligible for Wild and Scenic River designation and include Kennedy Creek (proposed Wild and Scenic River), Relief Creek South Fork Stanislaus River, Buck Meadow Creek, Summit Creek, and the Cherry Creek system.

A majority of Wilderness recreation use occurs from early July through early September. Kibbie Ridge Trail can be an exception because of exposure to summer sun and heat. Recreation use does occur outside of the peak times, but visitation is considerably lower due to weather, access, school schedules, and deer hunting season. Because of the popularity of equestrian activities the Aspen Meadow and Kennedy Pack Stations operate under Outfitter and Guide Special Use Permits to provide horseback riding and pack and saddle service to Wilderness visitors.

The Emigrant Wilderness is contiguous with Yosemite Wilderness to its south. Most recreation within the area originates from the Kibbie Ridge and Lake Eleanor Trail Heads. Popular destinations from these trail heads include Eleanor and Kibbie Lakes in Yosemite National Park (Wilderness). (USDA 2014)

Wilderness: Environmental Consequences

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Alternative 1 proposed treatment units do not occur within the Wilderness. Actions within a mile of the Wilderness boundary include thinning and reforestation to the south and southwest. A reforestation unit is located within 0.5 mile of the Wilderness boundary, and the nearest deer broadcast burn is over 2 miles to the southwest.

Herbicides and Noxious Weed Eradication

Herbicide use and noxious weed eradication activities would not affect Wilderness character.

Reforestation

Reforestation units are located within a mile of the Wilderness boundary. Planting work would be done by hand and on foot, and is not expected to affect Wilderness character. Some mechanical preparation work would occur, including the use of feller bunchers, excavators, and saws. Visitors near the Wilderness boundary would be able to hear the sights and sounds of these activities. However, as they travel farther into the Wilderness the noise would become reduced.

Thinning

In the geographic extent, visuals (project activity), noise and dust produced during ground based activities may negatively disrupt the solitude qualities of Wilderness character. The sounds of chainsaws may be audible until visitors travel further into the interior. These effects are expected to be short-term and only persist near the Wilderness boundary. Some visitors may temporarily change their activities and destination, particularly those who want to camp near the boundary. The untrammeled, natural and undeveloped qualities of Wilderness character would not be affected.

Understory Burning

Wilderness visitors may be able to see and smell smoke from high points or vistas within the Wilderness. However, due to the distance from the proposed units, this is not anticipated to negatively affect Wilderness character.

CUMULATIVE EFFECTS

Anticipated and reasonably foreseeable activities occurring in the Wilderness and near the boundary include road and trail maintenance, visitor use monitoring, campsite rehabilitation and fire suppression. The Reynolds Creek Ecological Restoration project, occurring to the east, includes thinning and burning. Most visitors expect to see increased presence of humans near boundary and transition areas. When considered with other activities occurring in the area, implementation of Alternative 1 activities are not expected to have a cumulative long-term effect on Wilderness character.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

Under Alternative 2, no treatments would occur. Choosing Alternative 2 would not impact the outstanding opportunities for solitude, untrammeled, natural and undeveloped or primitive and unconfined qualities of Wilderness character.

CUMULATIVE EFFECTS

There are no direct or indirect effects, so there are no cumulative effects.

Alternative 3

DIRECT AND INDIRECT EFFECTS

Same as Alternative 1.

CUMULATIVE EFFECTS

Same as Alternative 1.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Alternative 4 would propose no other treatment units except for several complex early-seral forest units (prescribed burning) directly adjacent to the Wilderness boundary on the southern end. The presence of smoke could temporarily bother Wilderness visitors depending on prevailing winds. Depending on the length of time for burning, presence of large fuels smoldering, and atmospheric stability, smoke could linger for a few days. Some visitors may alter their plans and choose different routes of travel. However, since only 50% of the complex early-seral forest units would be burned in a moderately long fire return interval (10 years), smoke effects would be minor. No long-term effects are expected.

CUMULATIVE EFFECTS

Same as Alternative 1.

Alternative 5

DIRECT AND INDIRECT EFFECTS

Same as Alternative 1.

CUMULATIVE EFFECTS

Same as Alternative 1.

Summary of Effects Analysis across All Alternatives

Special Interest Areas

JAWBONE FALLS HERITAGE AREA

For all action alternatives, any proposed treatment measures within the Jawbone Falls SIA would be limited to small diameter non-commercial timber (biomass) and hazard trees approved by the Tribe that would enhance or protect those cultural values that make the SIA significant and unique. Anticipated effects for Alternatives 3, 4 and 5 are the same as Alternative 1. No anticipated direct effects and minimal indirect and cumulative effects to cultural resources are expected under Alternative 2 (No Action), as no project activity would occur.

PACIFIC MADRONE BOTANIC AREA

Under Alternatives 1, 3, 4 and 5, no direct, indirect or cumulative effects are expected in the Pacific Madrone SIA. Indirect effects under Alternative 2 include damage from falling trees.

Wild and Scenic Rivers

With the exception of minor, short-term impacts to the scenic quality from drift smoke, none of the alternatives are expected to change the free-flowing quality of any of the designated or proposed Wild and Scenic Rivers. Maintaining high water quality is also needed to maintain Wild and Scenic values. Management requirements minimize water quality impacts in all of the action alternatives. ORVs of each river are expected to be unchanged in each alternative.

Wilderness

Wilderness character is not expected to change or diminish from project activities. Short-term, minor effects to solitude could occur from the sights and sounds of workers or equipment; however, this would be limited to the areas near the Wilderness boundary where most visitors have expectations of encountering people and activity. The presence of drift smoke could obscure views and temporarily change the unconfined nature of the Wilderness experience, but this is expected to be minor and not cause long-term effects. Most activities would take place outside the regular Wilderness use season.

3.13 VEGETATION

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

The **National Forest Management Act** of 1976, Sec. 4. (d)(1), states that "It is the policy of Congress that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth and conditions of stands designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans." Furthermore, the Act requires that "All national forest lands treated from year to year shall be examined after the first and third growing seasons and certified … as to stocking rate, growth rate… Any lands not certified as satisfactory shall be returned to the backlog and scheduled for prompt treatment" (NFMA 1976).

The **Forest Service Land Management Planning Handbook** (FSH 1909.12) shows the vision for ecosystems is to have ecological integrity and adaptive capacity. The handbook states: "Ecosystems have integrity when their composition, structure, function, and connectivity are operating normally over multiple spatial and temporal scales" (USDA 2015b, p. 58). The handbook provides the following definitions, which are provided here for reference and clarification (USDA 2015c).

- **Adaptive capacity**: The ability of ecosystems to respond, cope, or adapt to disturbances and stressors, including environmental change, to maintain options for future generations. As applied to ecological systems, adaptive capacity is determined by genetic diversity of species, biodiversity within a particular ecosystem, and heterogeneous ecosystem mosaics as applied to specific landscapes or biome regions.
- **Ecological integrity**: The quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence.

Forest Service Region 5 developed guidelines for ecological restoration to help retain and restore forest resilience and provide a sustainable ecosystem from a broad range of services to humans and other organisms (USDA 2011a). Within Region 5, three major drivers of change have been identified: climate change, shifting hydrologic patterns and increasingly dense unhealthy forests coupled with rapidly growing human populations. Ecological restoration will be the core objective used to promote an all lands approach to restoration. Vegetation and fire management will support the development of biodiversity and ecological processes before and after fire disturbance, and ensure the retention of forest resources over the long-term. This approach will promote activities that include the following:

- Reforesting after wildfire and implementing suitable stand maintenance activities that meet project goals and site conditions.
- Forest thinning and prescribed fire to decrease fuel loading and increase forest heterogeneity.
- Providing wildlife and plant habitat for threatened and endangered species.

Forest Plan Direction (USDA 2010a) provides broad management goals and strategies that address problems related to old forest ecosystems and associated species (p. 11). These goals and strategies include:

- Increasing the frequency of large trees, increasing structural diversity and improving the continuity and distribution of old forests across the landscape.
- Restoring forest species composition and structure following large scale, stand-replacing disturbance events.
- Restoring ecosystems across all land allocations following large-scale catastrophic disturbance events.

Forest Plan Direction outlines management practices that are actions that achieve the goals and objectives of the Forest Plan (p. 17-32). Actions applicable to the Rim Reforestation project include:

- All activities necessary to reestablish desirable tree species by artificial methods on deforested areas. Minimum standards for reestablishment are contained in the Regional Standards. Activities included in this practice are: preparation of the seed bed or planting site; planting seedlings or direct seeding; saving natural regeneration; animal, insect and disease control when necessary; and examinations, evaluation, certification and monitoring of stands to achieve the reestablishment objectives.
- Activities necessary to reduce the effect of competing vegetation, animals, insects and disease on the growth and development of desired tree species.
- Removal of surplus trees in areas with excess stocking by cutting, mowing or herbicide injection to favor potential crop tree growth and development. Excess trees thinned do not have a commercial value because of tree size, species comparison or access to available markets.
- Removal of trees in stands of less than rotation age to periodically reduce the stocking level to a point where the stand will grow back to 90% of normal stocking as indicated in-yield tables within a specified time period. There are no minimum or maximum treatment area sizes. This cutting method applies to stands on all forest types which carry stocking in excess of desired amounts.

Forest Plan Direction outlines forestwide standards and guidelines that provide management direction applying to all Forest lands (p. 33-64). Specific standards and guidelines that are applicable to the Rim Reforestation project include:

- Maintain the species composition of the major forest types existing where projects occur.
- Promote shade intolerant pines (sugar and ponderosa) and hardwoods.
- Where possible, create openings around existing California black oak and canyon live oak to stimulate natural regeneration.
- Retain the mix of mast-producing species where they exist within a stand.

Forest Plan Direction outlines direction and standards and guidelines that apply to specific management areas (p. 65-164). Management areas applicable to the Rim Reforestation project include: Wildlife (p. 123-127) and General Forest (p. 161-164). Direction and standard and guidelines for these management areas are the same:

- Reforest all openings in available, capable and suitable lands for timber production created by timber harvest, wind, fire, or insect and disease pests.
- Preparation of sites for artificial or natural stand reestablishment will be completed sufficiently in advance of planting or natural seeding to provide control of competing vegetation. Normally control of competing vegetation will be designed to ensure prescribed first year survival of planted or natural seedlings. This will often involve more than one treatment on more than one competing species prior to planting. It may involve a variety of techniques including fire, mechanical bunching and shredding, discing and pesticides. Pest management will be considered as necessary.
- Natural seeding or planting will be done with tree species, seed zones and elevations determined to be appropriate through a silvicultural examination and prescription.
- Reduce the effect of competing vegetation on the growth and development of desired species on lands available, capable and suitable for timber production.
- Release efforts will only be done after appropriate stand examination and prescription. The objective will be to treat stands before brush or undesired hardwood densities reach 10,000 cubic feet per acre. Ideally competing vegetation will be treated while seedlings and sprouts from this vegetation are small and easily treated by a variety of techniques. Often this will be within two or three years after site preparation. On plantations five years or older where conifers are established

over most of the site, the objective will be to treat competing vegetation based on the actual growth and development of the tree stand. Brush and undesired vegetation will be treated where the conifer stand is not meeting site objectives for growth and it is apparent that competing vegetation is the cause. A variety of techniques including mechanical piling, shredding, hand grubbing and herbicides may be used.

- Remove surplus trees on available, capable and suitable lands with excess stocking. This will be done to favor growth and development of potential crop trees, prevent disease and insect outbreaks, or meet other resource objectives.
- Pre-commercial thinning is a tool that will be used to maintain diversity by improving species composition in many stands. A variety of techniques may be used including crushing, piling, shredding, hand cutting and pesticides.
- Design cutting methods to obtain specific management objectives for late successional Management Indicator Species (MIS habitat).

Effects Analysis Methodology

Assumptions Specific to Vegetation

- Plot data, field observations and severity mapping are representative of the project area. Severity mapping measures the fire severity present at about 30 days after fire containment; however, it does not measure the effects of drought and insects that can occur after images are processed.
- Region 5 CALVEG cover types conifer (CON) and mixed hardwood-conifer (MIX) represent suitable and productive forestland.
- Post-fire conditions assume the Rim Recovery and Rim HT projects are fully completed or will be completed prior to Rim Reforestation treatment activities.
- Examples of post-fire reforestation and secondary succession are representative of the Rim Reforestation project area. Most of the examples are taken from neighboring projects or other areas of the Sierra Nevada; therefore, this is a reasonable assumption.
- Current and recent climate conditions provide a reasonable baseline for this analysis time frame (about 60 years). Temperatures in the Sierra Nevada have become incrementally warmer since the 1960s (Thorne et al. 2008) and are expected to continue warming (Safford et al. 2012). This analysis assumes this trend will continue, but not to an extent that loss of habitat suitability over the next 50 to 60 years would be significant. In other words, no dramatic shifts in vegetation would occur beyond what has or is currently being observed. Tree competition-related thresholds of stand density are still applicable as they relate to insect, disease and drought.

Data Sources

- Survival exams from the Mi-Wok and Groveland Ranger Districts covering 4,966 acres of plantations established in the 1980s and 1990s.
- Field observations and plot data. Two datasets were developed to assess post-fire conditions. From 2014 to 2015 field crews conducted walkthroughs of each proposed unit noting operability; need for reforestation, thinning and fuels reduction; and, post-fire response of shrubs and other herbaceous vegetation. Fixed area circular plots (50th-acre), distributed on a systematic random grid (656 feet by 656 feet) were used to collect information about: natural regeneration, competing vegetation cover, distance to potential seed source and whether or not the plot had been impacted by post-fire mechanical operations. Complete details about the plot sampling protocol are available in the project record.
- Common stand exam (CSE) data collected in the Rim Fire perimeter. Data downloaded from the Natural Resources Management Natural Resource Information System (NRM NRIS) Field Sampled Vegetation Database (FSVeg). A total of 843 CSE plots were collected between 2005 and 2013 (prior to the 2013 Rim Fire).
- California Wildlife Habitat Relationships (CWHR, CDFW 2014b) and CALVEG cover types.

- GIS data including: Rapid Assessment of Vegetation Condition (RAVG) analysis mapping, Worldview Imagery, Soil Survey Geographic (SSURGO) database for the Stanislaus, land allocations, project unit boundaries and road treatments.

Vegetation Indicators

The following indicators provide a relative measure of the direct and indirect effects to changes in forest vegetation due to project alternatives. They are intended to respond to the agency vision of promoting ecological integrity and adaptive capacity (USDA 2015b; USDA 2015c).

TREE SIZE AND SPECIES COMPOSITION

- Average tree diameter at breast height (dbh) at years 10, 20 and 60.
- Average tree height at years 10, 20 and 60.
- Percent trees per acre by species, in particular shade-intolerant pine (sugar and ponderosa) and hardwoods.
- Relative change in abundance of understory vegetation (shrubs, grasses and forbs).

Tree size influences many different aspects of forest ecosystems. This is especially true for large trees, which contribute disproportionately to reproduction (van Wagtendonk and Moore 2010), are critical wildlife habitat features (North et al. 2000; Zielinski et al. 2004) and contribute to fire resiliency (Agee and Skinner 2005; Brown et al. 2004; van Mantgem et al. 2011). The number of trees per acre is used to describe the recovery of tree density, forest structure and habitat. It provides a basis for comparing the direct and indirect effects to species composition, which is important in assessing forest health and resiliency. Species composition is also an important component of wildlife habitat and strongly influences ecosystem processes and functions (Tilman et al. 1997; CREP 2008).

STAND DENSITY INDEX

- Years until tree densities reach or exceed the stand density index (SDI) zone of increased bark beetle-related mortality (SDI of about 230 or about 45% of maximum SDI) and the bark beetle induced maximum SDI of 365.

Tree density influences the dynamics of vegetation competition, tree growth and forest health. SDI is an age and site productivity-independent measure of density. SDI is used to evaluate forest health and vigor in terms of resiliency of trees to drought, insects and disease. In general, higher stand densities predispose trees to damage or mortality. Bark beetles and disease agents are often more damaging at high densities and also limit diameter growth. Densities below 55 to 60% of the maximum SDI level provide for reduced density-related mortality and relatively high vigor (Oliver 1995; Long and Shaw 2012). According to Oliver (1995) and Oliver and Uzoh (1997) ponderosa pine stands, especially plantations, start to show increased bark beetle-related mortality at SDIs above 230 (about 45% of maximum SDI). They also suggest the possibility of a bark beetle induced maximum SDI of 365, though they state that outbreaks often reduce stand density to levels well below that SDI.

FUTURE MANAGEMENT FEASIBILITY

- Years until stand densities near or exceed the threshold of imminent competition-related mortality (SDI of about 260 or 50% of maximum; Long and Shaw 2012) and can produce at least 2,000 board feet per acre if thinned to SDI 170 (about 35% of maximum).

An obvious effect of regenerating conifer forests is the future ingrowth of small trees and accumulation of surface fuels (e.g., tree litter and shrub cover). Even in the absence of coniferous trees, vegetative biomass will accumulate over the next several decades and contribute to fuel loading in the absence of fire. This is evident in historical records, which indicate that fire played an essential role in moderating shrubs, tree regeneration and tree development even with low overstory tree densities (Collins et al. 2015; Show and Kotok 1924; Sudworth 1900). Furthermore, shrub cover is a good predictor of fire behavior (Lydersen and North 2012; van Wagtendonk et al. 2012), and can contribute to high-severity fire (Harris and Taylor 2015; Lydersen et al. 2014). Today, prescribed burning and managed wildfire are faced with numerous operational and social constraints that limit their use in effectively reducing hazardous fuels and maintaining natural processes (Quinn-Davidson and Vaner 2012). An important alternative to fire has been the use of mechanical thinning to reduce ladder and canopy fuels through the removal of trees and other vegetation (Graham et al. 1999; 2004). To create resilient stands, however, mechanical thinning is more effective when accompanied by reduction in surface fuels either by prescribed surface fire or piling and burning (Agee and Skinner 2005; Reinhardt et al. 2008). Therefore, we are faced with the reality that effective suppression and containment of wildfire is more likely with the complementary use of both mechanical thinning and prescribed fire (North et al. 2015). Although the focus is often set on the costly removal of small-diameter trees and surface fuels, such costs can be offset through the necessary removal of some merchantable intermediate sized trees to maintain low canopy bulk density and open stand conditions, as well as accelerate development of large trees (Moghaddas and Craggs 2007; North et al. 2009). It stands to reason then that management feasibility would improve if increasing fuel loads and stand densities are balanced with larger trees that can at least partially offset operational costs when thinned.

CHANGE IN FOREST STRUCTURE

- Change in the proportion of forest successional classes.

The Rim Fire changed vegetation conditions across the project area. The fire killed and injured trees and shrubs, which changed forest structure and habitat. Treatments have the potential to change post-fire forest structure and resulting habitat. This analysis uses the Region 5 CALVEG classification system to evaluate changes in forest successional stages.

The CALVEG system conforms to the upper levels of the National Vegetation Classification standards hierarchy. This analysis used the CALVEG vegetation cover type to identify a general distinction between broad vegetation types: conifer (including mixed hardwood and conifer), hardwood, shrub, grass, barren and other life form classifications. The primary focus of this analysis is the conifer and mixed hardwood-conifer cover types. Within these two conifer-dominated cover types, CWHR vegetation type, size class and density were used to describe forest structure. Table 3.13-1 shows size classes 0 to 2 are usually indicative of young trees, habitat best described as dominated by seedlings and saplings. Larger size classes are often interpreted as “old” or “mature” forest. Large size classes can take 40 to 150 years to develop. Multilayered forest provides a variable tree structure; both large and medium trees are present with saplings or small trees. These multistory forests develop in a variety of ways; however, the large tree component takes the longest to develop.

Table 3.13-1 California Wildlife Habitat Relationship (CWHR) size classes

CWHR Size	Description	Diameter at Breast Height
1	Seedling	Less than 1 inch
2	Sapling	1 to 6 inches
3	Pole	6 to 11 inches
4	Small tree	11 to 24 inches
5	Medium/Large Tree	Greater than 24 inches
6	Multilayered	Size 5 over size 4 or 3; total tree crown closure greater than 60%

Table 3.13-2 shows density of forest cover is expressed in terms of tree canopy cover. Dense forest cover can develop in as little as 10 years when dominated by small trees; or take hundreds of years when dominated by large trees.

Table 3.13-2 California Wildlife Habitat Relationship (CWHR) density classes

CWHR Density	Description	Canopy Cover
blank or X	No cover, definite forest habitat	Less than 10%
S	Sparse cover	10% to 24%
P	Open cover	25% to 39%
M	Moderate cover	40% to 59%
D	Dense cover	Greater than 60%

In a bioregional assessment for natural range of variability, Safford (2013) provides an estimate of historic landscape variability based on LANDFIRE biophysical settings (BpS) state and transition models. The BpS represent the vegetation that may have been dominant on the landscape prior to Euro-American settlement and is based on the current biophysical environment and an approximation of the historical disturbance regime, but with the current climatic conditions (LANDFIRE 2009). Reference landscape forest structure is described using five successional classes (seral stage) for yellow pine and mixed conifer (YPMC) forests in the Sierra Nevada: early successional, mid successional (open and closed canopy) and late successional (open and closed canopy). Early successional is described as vegetation not dominated by trees greater than 4 inches dbh, which includes areas dominated by herbaceous plants, shrubs, seedlings and saplings. Open canopy for mid and late successional stages is defined as less than 40 to 50% canopy cover and closed canopy is greater than 40 to 50% canopy cover. Mid successional stages are defined by trees 5 to 21 inches dbh and late successional stages are defined by trees greater than 21 inches dbh. These definitions are quite similar to the CWHR size and density classes; therefore, this analysis adapted the CWHR size and density classes shown in Table 3.13-3 to these successional classes for comparison to reference forest landscape structure.

Table 3.13-3 Adaption of CALVEG and CWHR to Forest Successional Classes

Forest Successional Class[1]	CALVEG Cover Type	CWHR Size	CWHR Density	Historic Forest Landscape
Early	Conifer and mixed hardwood-conifer	2 or less	ALL	15 to 20%
Mid seral open canopy (mid-open)	Conifer and mixed hardwood-conifer	3 and 4	S, P	20 to 30%
Mid seral closed canopy (mid-closed)	Conifer and mixed hardwood-conifer	3 and 4	M, D	5 to 15%
Late seral open canopy (late-open)	Conifer and mixed hardwood-conifer	5 and 6	S, P	25 to 45%
Late seral closed canopy (late-closed)	Conifer and mixed hardwood-conifer	5 and 6	M, D	5 to 20%

[1] As defined by Safford (2013)

Vegetation Methodology by Action

The methodology for evaluating effects on vegetation is based upon assessing changes to vegetation following the Rim Fire and the associated timber salvage, hazard tree abatement and fuels reduction work. The analysis evaluates cumulative changes in vegetation composition, growth and structure caused by the project activities as well as the Rim Reforestation project. Changes in vegetation are assessed post treatment and over a 60-year time frame. This temporal scope was selected because the impacts to seedling survival and growth, species composition and forest structure at a given location can accumulate over time from different activities or events. The analysis compares effects found in scientific literature to the effects experienced with similar treatments on the Stanislaus.

DIRECT AND INDIRECT EFFECTS

Unless otherwise specified, the analysis area used to analyze the direct and indirect effects on forest vegetation is 41,933 acres and includes only NFS lands within the Rim Fire perimeter. The analysis area is based on the Rim Reforestation project treatment unit area where project activities would impact forest vegetation. It includes 26,009 acres of reforestation activities (including natural regeneration and deer habitat enhancement with reforestation), 13,934 acres of prescribed fire with thinning and 1,990 acres of prescribed fire only for deer habitat enhancement. The analysis encompasses hardwood forest, chaparral, grasslands and riparian vegetation; however, given the administrative and ecological setting of the affected environment, as well as the purpose and need of the project, the analysis primarily focuses on coniferous forest.

CUMULATIVE EFFECTS

Cumulative effects on vegetation are analyzed at the project scale. Vegetative cumulative effects are additive. That is they are the total of changes of proposed treatments to vegetative structure. The project scale analysis allows for comparison of changes that are occurring as a result of the past, present and reasonably foreseeable projects across several large watersheds. Changes in coniferous forest have the greatest potential for cumulative effects on conifer establishment, species composition and forest structure. Although the cumulative effects analysis focuses on the project scale, the effects of the project on landscape forest structure are sometimes discussed inside of the larger Rim Fire landscape (257,314 acres); however, evaluation of vegetation change beyond the project scale is limited and outside the scope of this analysis.

ANALYSIS

Natural regeneration is proposed in some treatment units. Natural regeneration in these units would be monitored to assess the need to release, alter species composition, or if necessary, conduct site preparation and planting. Although field assessments of these units suggest that natural regeneration is likely and reforestation treatments will not be needed, this analysis assumes all reforestation actions would be completed in natural regeneration units; therefore, analysis of all natural regeneration units are included with the analysis of other reforestation units to address all potential effects. No further distinctions between natural regeneration units and reforestation units are made in this analysis. Also, no special distinction is made for reforestation activities proposed for deer habitat improvement other than differences in planting density.

Assessment of Existing Conditions

Given the large number of treatment units and limited available resources, it was impractical to collect enough plot-level data within each unit to accurately assess conifer regeneration and vegetation composition on a per unit basis. Instead, this analysis first vetted the data using methods similar to Crotteau et al. (2013), stratifying plots across a gradient of four fire burn severities. Fire severity was determined remotely using Relative differenced Normalized Burn Ratio (RdNBR) derived from pre- and post-fire LANDSAT Thematic Mapper images, which are subsequently transformed to four nominal Composite Burn Index (CBI) categories: unchanged (minimal or no visible effect of fire), low-severity, medium-severity and high-severity. RdNBR has been tested in similar conifer dominated vegetation types and proven to produce fire severity classifications with similar accuracy as other fire mapping processes (Miller et al. 2009a).

Reforestation

The analysis of conifer forest establishment and growth required a synthesis of local reforestation records, scientific literature and plot data. This synthesis helped parameterize two forest growth models used to evaluate the short- and long-term changes in vegetation: CONIFERS in R (RCONIFERS) and the Forest Vegetation Simulator (FVS).

Growth Models

RCONIFERS was used to predict growth and development of trees and competing vegetation in the project area to age 20. RCONIFERS is a model for young stand growth developed by the Forest Service Pacific Southwest Research Station (Ritchie and Hamann 2015). In general, most forest growth and yield simulators are ineffective at simulating the growth of very young stands, especially any stand in which non-tree vegetation contributes significantly to the level of competitive stress to which trees are exposed (Ibid). The Southwest Oregon (SWO) variant of RCONIFERS was developed using data from mixed-conifer stands heavy to Douglas-fir in southern Oregon and heavy to ponderosa pine in northern California. The SWO variant is based on a limited list of conifer, hardwood and shrub species. The list includes all major conifer tree species found in the project area and the majority of the dominate hardwood and shrub species. With the exception of bearclover (*Chamaebatia foliolosa*), the SWO variant is the most appropriate model available to forecast the dynamic effect of competing vegetation on young forest growth in the project area. Although bearclover is not included in RCONIFERS, its effects on young conifer establishment and growth have been studied for several decades (McDonald et al. 2004). To account for the effect of bearclover competition, conifer growth in RCONIFERS was projected in the absence of competing vegetation (free to grow). Findings from scientific literature were then used to adjust conifer height and diameter growth accordingly.

The FVS Western Sierra Nevada Variant was used to simulate tree growth and summarize forest structure beyond age 20. The FVS projections use the default growth rates, which are calibrated to reflect inter-tree competition of established stands that have developed to a point where non-tree vegetation plays a minimal role in tree growth. This distinction between FVS and RCONIFERS is important to note for this analysis because growth projections are transitioned between the two models at age 20 despite tree size. This could affect long-term growth projections by essentially eliminating the variable of competitive stress caused by non-tree vegetation from the growth models at year 20. The effect is likely most pronounced in alternatives where early conifer growth has been reduced the most, resulting in the smallest tree heights and diameters at year 20. The aboveground photosynthetic potential of young trees is balanced by belowground root development and the ability to effectively compete for limited water and nutrients (Grossnicle 2005); therefore, these smaller trees are still aggressively competing with other vegetation and growing at a reduced potential compared to trees that have benefited from about two decades of greater root development and height growth. Removing the effect of non-tree competition at year 20 artificially provides these smaller trees a window of relatively free to grow conditions until they reach a size where inter-tree competition becomes a factor. During this period, trees that were larger at age 20 would experience a potentially smaller window of free to grow conditions before the onset of inter-tree competition.

While computer models attempt to display the complex reality of vegetation; modeling results fall short of a precise (perfect) depiction of the variability of real forest vegetation. This short-coming is due to the variability associated with measuring vegetation, the variability in locating plots, the errors associated with drawing boundaries around vegetation and the ability of algorithms used in the computer models to effectively emulate natural variability. Despite these short-comings, computer models do provide a means for relative comparison.

Model Parameterization

Given the large scale of this project, a variety of model states, or scenarios, representing common conditions were identified and analyzed rather than simulating forest growth of every treatment unit for each alternative. This approach was used partly because plot data was limited on a per unit basis. While a robust dataset was created by collecting data from numerous plots across the project area, there was only a subset of units that had more than a few plots. Having a small sample within a unit increased the likelihood of outlier plots having undue effects on describing existing conditions. For example, a unit might have abundant conifer regeneration and little competing vegetation. If only one plot was completed in that unit and it happened to land in a patch of shrubs with no conifer regeneration, then the data would misrepresent the broader existing conditions across the unit.

The modeling scenarios were based on the five alternatives and their associated planting patterns, which are determined by slope position (2.02 Alternatives Considered in Detail). Like FVS, RCONIFERS is a semi-distance-independent individual tree growth model. In general, this means it does not readily account for the distance between individual trees and how the proximity and arrangement of neighboring trees might influence individual tree development. Rather, tree growth and development is determined by stand-level conditions (e.g., trees per acre), thereby, inferring distance to neighboring trees given that conditions in a stand are consistent. Basing stand-level conditions on plot-level data, however, does provide some ability to model localized competition and site variables within a stand (Dixon 2002). Attempting to model the fine-scale nuances of the various proposed planting patterns would have resulted in a tenuous and overwhelmingly complex analysis with numerous scenarios (greater than 100) after factoring in biophysical variables. Instead, a simplified approach was used that based the modeling scenarios on slope position and planting density, assuming this would provide an adequate representation of the predominant conditions and vegetation dynamics germane to this analysis. Effects of fine-scale planting patterns on individual trees are left to qualitative discussion. Both RCONIFERS and FVS structure input data by stands and plots within stands. Therefore, each scenario was treated as a stand. To account for the range of biophysical factors, mock plots were developed within each scenario's stand (i.e., topographic slope position) based on environmental factors, density of hardwoods, competing vegetation and natural conifer regeneration as summarized from plot data.

Environmental Factors

The following environmental factors were incorporated into RCONIFERS: elevation, aspect, percent slope, water holding capacity, annual precipitation and growing season precipitation. Water holding capacity was determined using the available water supply (AWS) from the Soil Survey Geographic database (USDA 2008a). The available water supply is defined as the total volume of water available to plants when soil is at field capacity (USDA 1999). Mean annual precipitation (36.8 inches) and mean growing season precipitation (3.2 inches) were calculated based on precipitation records from the last 15 years (WRCC 2015).

Competing Vegetation

Variability within each slope position was addressed by identifying dominant shrub types based on plot data. After categorizing plots into dominate shrub types, the proportion of plots within each slope position by shrub type were calculated. Overall, bearclover and deerbrush (*Ceanothus integerrimus*) were disproportionately the dominate shrub species on the most plots (greater than 72% of all plots). Manzanita (*Arctostaphylos* spp.) was the third most common dominant shrub in the project area, but on a much smaller proportion of the plots (8.5%). Given the large number of plots dominated by deerbrush and bearclover, these shrub types were used to represent competing vegetation in RCONIFERS. That is, within each slope position all the deerbrush plots were averaged to estimate the species composition, cover and height of deerbrush and associated vegetation (i.e., other shrubs, grasses and forbs). This approach accounted for both the abundance of deerbrush and other shrub species, grasses and forbs. As mentioned previously, RCONIFERS does not include bearclover, so conifer growth adjustments were made based on scientific literature. Details on methodology and growth adjustments associated with bearclover are discussed in the following sections.

Natural Conifer and Hardwood Regeneration

Natural conifer regeneration was only used to model Alternative 2 and areas in Alternative 4 that would not undergo artificial reforestation. For the action alternatives and in areas proposed for reforestation under Alternative 4, planting or control of natural conifer regeneration was assumed to only occur in areas where natural regeneration was not meeting desired conditions; therefore, desired conifer stocking and species composition would always occur under these scenarios whether it be natural or artificial.

Density of natural conifer and hardwood regeneration was estimated using plot data stratified across slope positions. Salvage and fuels reduction operations can reduce survival of naturally regenerating conifer seedlings through soil disturbance and physically burying seedlings in woody material (Donato et al. 2006). Although each plot was not sampled twice to explicitly assess pre- and post-logging conditions, data was collected in recently logged areas and in areas scheduled for salvage operations, but not yet completed. Assuming natural regeneration in these areas was relatively similar prior to mechanical operations, natural regeneration in logged and unlogged areas was compared. While both hardwood and conifer regeneration was lower in areas that had been logged, hardwood densities were impacted less. The majority of the oak and hardwood regeneration occurred in the form of stump sprouts, which are less vulnerable to damage by mechanical operations than small seedlings germinated from seed. For example, plots with top-killed oaks were likely less impacted by mechanical equipment given presence of standing dead oak and not conifers. Conifer regeneration, however, is more vulnerable to mechanical operations because it only regenerates from seed within close proximity to species typically targeted for salvage. Plot data suggests that salvage and fuels reduction operations reduced conifer regeneration density by 72% and oak regeneration by about 26%; however, the proportion of null plots were minimally impacted. When comparing logged to unlogged plots, there was less than a 4% difference in the proportion of plots without conifer regeneration. Because plot data was collected in some areas prior to the scheduled salvage and fuels reduction activities, results from these plots were adjusted to account for the estimated 72% reduction in seedling density that might result from mechanical operations.

Survival of Natural Regeneration

Aside from effects of salvage and hazard tree abatement operations, all hardwood regeneration is expected to initially survive and only experience mortality related to SDI thresholds built into default model settings. As already noted, the majority of hardwood regeneration is from root and stump sprouts, which afford these species ready-access to water and nutrients. Conifers, however, are expected to experience some levels of mortality as they must expend resources toward root development before they can invest in aboveground growth (Grossnicle 2005). Saigo (1969) found that pine would initially establish in high numbers, but quickly decline due to various factors such as predation, competition and poor microsite conditions. These studies suggest that conifer seedling survival is probably highly diverse and influenced by numerous factors including the species, competing vegetation, site conditions and climate.

This analysis based survival of naturally regenerating conifers on research conducted on planted conifers. This approach was taken because it helped control for the two very distinct shrub types being modeled for this analysis (deerbrush dominated and bearclover dominated), which would provide some diversity of results that are likely to occur. McDonald and Abbott (1997) reported between 99 and 81% survival of planted conifers over the course of an 18-year study on the effects of competing vegetation and young conifer growth. The study included a variety of shrub, grass and forb species common in Sierra Nevada mixed conifer forests, but did not include bearclover. Conifer survival rates were lowest in the high shrub cover plots and highest in the no shrub cover plots. Average survival rates of these low and high shrub plots (90%) was assumed to reflect the variation of potential natural seedling survival in areas dominated by deerbrush.

High initial bearclover cover (20 to 40%) can substantially decrease initial conifer survival by as much as 80% or more (Tappeiner and Radosevich 1982; McDonald and Fiddler 1999). Tappeiner and Radosevich (1982) reported only 13% conifer survival after 19 years in study plots with 20 to 40% bearclover cover. Reducing initial bearclover cover increased conifer survival to 71% (Tappeiner and Radosevich 1982). Other studies reported similar conifer survival (69 to 73%) in study plots that had 20 to 30% bearclover cover present in the first few growing seasons (McDonald and Everest 1996; McDonald and Fiddler 1999). Therefore, it was assumed that 71% of the natural conifer regeneration would survive in bearclover-dominated shrub types that had less than 30% bearclover cover and 13% of the natural conifer regeneration would survive in bearclover-dominated shrub types that had greater than 30% bearclover cover.

Research investigating effects of bearclover on growth of young ponderosa pine suggests that the majority of mortality occurs in the first few years after seedling establishment (Tappeiner and Radosevich 1982); therefore, natural regeneration mortality was incorporated into all model scenarios during the first projected growing season. Any additional mortality during the first 20 years was accounted for using default settings in RCONIFERS for SDI-related mortality. Default FVS mortality settings were used for projections beyond year 20.

Future Conifer Dispersal and Establishment

Conifer dispersal was not modeled in this analysis. The CWHR definition of shrub-dominated vegetation types require at least 10% shrub cover and less than10% cover of tree species. The definition for the mixed hardwood-conifer forest type requires at least 25% cover of conifer species when there is greater than 50% cover of hardwood species. Therefore, at least 10 to 25% conifer cover is required to be classified as a conifer vegetation type. Post-fire conifer dispersal, establishment and growth are influenced by shrub and hardwood vegetation. Findings from Shatford et al. (2007) indicate that conifer seedling establishment declines over time with an initial pulse in conifer establishment post-fire. This pulse of regeneration is likely the result of both conifer establishment near surviving mature conifers and dispersal and establishment of conifer seedlings that occurs during a short period of time when shrub and hardwood species are still responding to the fire; and therefore, have not yet dominated the site. Once all available growing space is occupied, conifer establishment steadily declines. Despite this increase in presence of established conifer seedlings, it does not necessarily suggest conifer dominance. Similar to plot data in the Rim Fire, high burn severity areas studied by Shatford et al. (2007) had much lower densities of pine regeneration compared to Douglas-fir or true firs, which comprised greater than 50 to 80% of the conifer regeneration. Shatford et al. (2007) found that distance to seed trees did not appear to be a major limiting factor in conifer seed dispersal; however, no indication is made as to how far specific conifer species were dispersing. Given the disproportionate abundance of Douglas-fir and true firs, these species likely accounted for the majority of longer dispersal distances. Despite gradual increases in establishment, Shatford et al. (2007) notes that even after 19 years “conifer seedlings were frequently overtopped by shrubs and hardwoods” (p. 144). Other studies have also observed dominance of non-pine regeneration in areas of high burn severity that is also commonly overtopped by other vegetation (Crotteau et al. 2013; Nagel and Taylor 2005; SNRC 2012). Research on the Tahoe National Forest concluded that high-severity patches created in four different fires required 30 to 50 years for conifers to establish (Russell et al. 1998). Additionally, other studies have demonstrated that large areas dominated by shrubs can considerably slow or inhibit the development of dry conifer forests (Barton 2002; Goforth and Minnich 2008; Roccaforte et al. 2012; Collins and Roller 2013).

Despite the presence of some conifers, their contribution to vegetative cover may not warrant reclassification from a CWHR shrub or hardwood dominated vegetation type to a conifer vegetation type. Although Douglas-fir and true firs are able to slowly disperse into large severely burned areas and persist among dense shrubs and hardwood vegetation even when overtopped for extended periods of time, their growth is greatly diminished (Conard and Radosevich 1982a; Conard and Radosevich 1982b; Nagel and Taylor 2005; Shatford et al. 2007). Shatford et al. (2007) noted that in addition to the sporadic nature of dispersal, conifer growth would be delayed for about 20 years until shrub growth slows, but beyond that “successional development cannot be precisely predicted for specific locations” (p. 145). Nagel and Taylor (2005) observed even longer periods of significantly stunted growth in white fir, noting that on average it took about 30 years for a white fir seedling to grow one foot in height and about 120 years of fire suppression for white fir to establish and overtake chaparral vegetation.

The long time frame required for recovery of conifer forest cover is also attributable to the time required for conifers to produce viable cone crops that allow for increased expansion. For example, immature white fir and ponderosa pine can produce seed crops, but their performance is more erratic than that of mature trees, which typically do not produce dependable cone crops until 40 to 60 years of age (Laacke 1990; Oliver and Ryker 1990). In California, ponderosa pine trees more than 25 inches dbh were the best producers (Oliver and Ryker 1990). The best seed producing size for white fir is between 12 and 30 inches dbh. Similarly, Douglas-fir seed production increases with age. Old-growth Douglas-fir may produce 20 to 30 times the number of cones than younger trees that are 50 to 100 years old (Hermann and Lavender 1990).

Based on the very slow dispersal and growth of conifers among shrubs and hardwoods, conifer expansion beyond the proportion of the analysis area already regenerating with conifers was not modeled during the analysis time frame of 60 years. During the analysis time frame, it is unlikely that significant acreage would experience an increase in conifer cover of more than the 10 to 25% required to qualify as a CWHR conifer forest type or mixed hardwood-conifer type. Nor would seedlings that might establish post-fire grow to an age or size that would result in significant additional seed fall within the next 60 years. Therefore, the proportion of plots with and without conifer regeneration were used to determine the acres that would reliably regenerate as conifer forest during the analysis time frame. All other acres were treated as chaparral or hardwood vegetation types.

Conifer Planting Density and Survival

Conifer planting was based on densities identified for each alternative and topographic position (2.02 Alternatives Considered in Detail). For each scenario, the 25-foot planting buffer on 5 oaks per acre were used to adjust the number of conifers planted per acre. Conifer planting densities were also adjusted to account for potential initial mortality that commonly occurs shortly after being planted. Local reforestation records from the 1990s covering 4,966 acres on the Mi-Wok and Groveland Ranger Districts were evaluated to determine the effects of different site preparation and release treatments on planted conifer seedling survival. Records were categorized into different site preparation and release categories according to the different action alternatives proposed under the Rim Reforestation project. Table 3.13-4 shows third-year survival exam results which were used to calculate an average percent survival, weighted based on plantation acres. Survival exam records distinguished between naturally regenerating conifers and planted conifers. The results presented here lump natural and artificial regeneration; thereby, incorporating potential natural regeneration that may occur within the Rim Reforestation project area.

Table 3.13-4 Third-Year Seedling Survival: Weighted Average Estimates Based on Local Records

Site Preparation and Release Treatments	**Planted in 1990s** (acres)	**Initial Planted** (per acre)	**Survived** (per acre)	**Percent Survival**[1]
Site preparation with herbicides or deep tilling with forest cultivation followed by herbicide release treatments	1,767	453	330	73
Deep till site preparation followed by manual releases	2,304	420	201	48
No site preparation followed by manual releases	895	390	110	28

[1] Seedling survival assumptions are based on these values rounded up to the nearest multiple of 5.

Of the 4,966 acres evaluated, 1,767 acres were treated with herbicides as shown in Table 3.13-4. While herbicides were used for release treatments on all of these acres, site preparation treatments included different combinations of herbicides and deep tilling with forest cultivation. Effects on seedling survival of site preparation with either deep tilling or herbicides were assumed to be similar; and therefore, lumped together. This assumption was made for two reasons. First, records for a large portion of the acres (732 acres) in one of the timber compartments evaluated (Walton Cabin) were incomplete; however, multiple Forest employees (both retired and still working for the Forest Service) that assisted with reforestation efforts in the 1990s confirmed that both deep tilling and herbicides were widely used in this compartment. Second, records from the other 1,035 acres indicate that when followed by herbicide release treatments, site preparation with deep tilling versus herbicides resulted in similar survival rates. On average, 73% of seedlings survived when prepped with herbicides versus 67% when prepped with deep tilling. Similarly, areas that were not site prepped, but were released using herbicides were included in this category based on the assumption that no site preparation was deemed necessary at the time. While all units under Alternatives 1, 4 and 5 are prescribed either herbicides or deep tilling for site preparation, as described in Chapter 2 these treatments would only be used if still deemed necessary at the time of implementation.

The remaining 3,199 acres were reforested without herbicides. Treatment and survival details for these acres are described in USDA (1995). About 2,300 acres were site prepped with deep tilling and released using manual grubbing. The other 895 acres were planted the first spring after the 1987 Stanislaus Complex Fire before competing vegetation had begun to respond.

Conifer Growth and Competing Vegetation

The Forest Service in Region 5 has extensive experience and a large body of research including long-term studies that clearly establish the effect of competing vegetation on the growth of young conifer trees. For example, in a 31 yearlong study McDonald and Abbott (1997) evaluated the effect of multiple shrub densities on the growth of ponderosa pine seedlings. Four shrub densities ranging from none to heavy were maintained for the first few years and pine growth was documented periodically for 26 additional years. At the end of the study, tree heights ranged from about 9 feet in the heavy shrub plots to just over 30 feet in plots with no shrubs. RCONIFERS was built using extensive study plots documenting the dynamics of young conifers and shrubs (Ritchie and Hamonn 2015); therefore, this analysis uses RCONIFERS to simulate the effect of competing vegetation on young conifers. As mentioned earlier, however, RCONIFERS does not include bearclover, so the effect of bearclover was analyzed based on relevant research.

Herbicide Control of Bearclover – Alternatives 1, 4 and 5

Multiple studies have shown that in the first few growing seasons, bearclover reduces conifer height growth by about 50% (Tappeiner and Radosevitch 1982; McDonald and Everest 1996; McDonald and Fiddler 1999). During these first years of growth, the ability of confer seedlings to grow in height and diameter is greatly dependent on root development and the ability of the seedling to access soil moisture (Grossnicle 2005). Lack of water stresses conifer seedlings by causing decreased root expansion, which reduces resource collection and causes losses in growth that are seldom made up (McDonald and Fiddler 2010). It has been well substantiated that suppressing competing vegetation during the first few years of tree development has the greatest impact on the survival and growth of conifer seedlings (Balandier et al. 2006; McDonald and Fiddler 2010). In a study near Mount Shasta, white fir seedlings were released with herbicides every year for the first 3 years and for the first 6 years after planting; however, treating for the first 6 years provided no significant gain over treating for the first 3 years (McDonald and Fiddler 2001). Conversely, when competing vegetation was not controlled during the first 3 years, but each year 4 to 6 years after planting, seedlings had statistically smaller average diameters than if released each year for only the first 3 years. In another study, 5-year old Douglas-fir seedlings grown with and without competition showed that the root biomass of seedlings in a free to grow environment was 9 to 22 times larger than those grown amongst sprouting shrubs whereas seedlings exposed to competition produced virtually no new root biomass (McDonald and Fiddler 2010). This critical period of early competition control has also been demonstrated in a study of northern conifers, which showed that the vegetation community and growth patterns established during the first 3 to 5 years after planting were relatively consistent through the subsequent 5 years (Wagner and Robinson 2006).

Although herbicide release treatments would not permanently eliminate bearclover or other competing vegetation (Tappeiner and Radosevitch 1982; Tesch and Hobbs 1989; McDonald and Fiddler 2010), herbicide release treatments would provide several years of free to grow conditions that would allow conifer seedlings to develop robust root systems that can effectively compete with other vegetation as it reestablishes following cessation of herbicide applications. Tappeiner and Radosevitch (1982) found that bearclover aggressively recovered after a single herbicide application, but this short-term setback still resulted in increased conifer growth. Multiple herbicide applications following planting will likely cause greater dieback of bearclover roots and rhizomes, which will increase the time necessary for bearclover to recover and afford conifer seedlings a longer period of reduced competition. After multiple applications of herbicides, it will likely take several years for most other competing vegetation to regain densities similar to current levels. By that time, however, conifers will be able to effectively compete for soil resources as well as slow shrub expansion with shade. Based on this critical period, herbicide release treatments in bearclover shrub types were modeled using free to grow conditions for the first 5 years. After 5 years, other competing vegetation was introduced back into the model to simulate some level of competition after release treatments stop.

No Control of Bearclover – Alternatives 2 and 4

While initial lower bearclover cover substantially increases conifer seedling survival; competition from bearclover can greatly reduce young conifer growth. After 3 growing seasons, plots that had lower initial bearclover cover versus plots with higher initial bearclover cover experienced 50% and 56% lower tree heights compared to a free to grow plot (Tappeiner and Radosevich 1982). After 19 years, the effect of bearclover on tree heights amounted to 67% and 72%, respectively. Although McDonald and Fiddler (1999) reported taller average tree heights at age 11 than that reported by Tappeiner and Radosvich (1982), they did not have a free to grow study plot to compare the effect of bearclover on conifer growth; therefore, this study could not be used to deduce the percent reduction in conifer growth that might have resulted from bearclover competition during the first several years of conifer development. The taller tree heights may have been a result of site conditions or other environmental factors. After modeling the natural conifer regeneration in a free to grow scenario, tree heights were adjusted according to bearclover abundance to reflect the findings of Tappeiner and Radosevich (1982). That is, all conifers in bearclover shrub types were modeled in RCONIFER without competing vegetation. Tree heights were then adjusted according to the abundance of bearclover. In bearclover shrub types with greater than 30% bearclover cover, free to grow tree heights were reduced by 72% after 20 years. In bearclover shrub types with less than 30% bearclover cover, tree heights were reduced by 67% after 20 years. Tree diameters were adjusted using species specific regressions of tree height-diameter relationships based on model outputs.

Partial Control of Bearclover – Alternative 3

While hand grubbing will kill the above ground portions of bearclover, belowground rhizomes will readily sprout and conifer seedlings will still experience some level of competition. Bearclover has been documented to aggressively recover following a single application of a single herbicide application (Tappeiner and Radosevich 1982). This is likely because a single herbicide application may reduce live root and rhizome biomass, but not completely kill the plant. Prescribed fire has resulted in similar effects by killing the aboveground portions of the plant, but the following spring it vigorously resprouts (McDonald and Everest 1996; McDonald et al. 2004). The same would be true for hand-grubbing bearclover, but manual treatment would likely be even less effective. To effectively control bearclover, both the below-ground and above-ground portions of the plant must be repeatedly disrupted (McDonald et al. 2004). For example, repeated herbicide applications reduce both the photosynthetic tissues and root biomass. Hand grubbing, even multiple times would only kill the top portion of the plant.

Although manual treatments would not directly kill bearclover roots, it would reduce root vigor as the plant would repeatedly experience reduced photosynthetic function and need to invest belowground resources into growing aboveground portions of the plant. Therefore, hand grubbing bearclover does provide some relief from soil moisture depletion that gives conifer seedlings an opportunity to make gains in root and shoot growth (Tappeiner and Radosevich 1982). Because the growth model RCONIFERS does not include bearclover, the effect of manual release treatments were based on the findings of Tappeiner and Radosevich (1982) for a single herbicide treatment. This study observed a small increase in conifer growth over the control study plots. These effects were compounded 5 times to account for 5 years of reduced competition from bearclover. A single herbicide treatment increased conifer mean annual height growth 0.056 feet between years 3 and 19 compared to the control (Tappeiner and Radosevich 1982). Assuming each additional year of release would increase mean annual height growth the same amount, 5 years of release would result in conifer heights of about 10 feet at age 19 as opposed to 6.2 feet with a single release. If free to grow conifers grew to 18.7 feet by age 19, then the effect of bearclover even with 5 releases that kill only the aboveground portions of the plant would result in a 46.5% reduction in height growth. Diameter growth was adjusted using the same height-diameter growth relationship described previously.

Prescribed Fire in New Plantations

Prescribed fire would only be introduced to new plantations after 10 years if fuels conditions meet specific criteria (3.05 Fire and Fuels). As a result, it is likely that some new plantations would not meet these criteria. Where prescribed fire is introduced, conifer mortality would likely vary considerably, but burning would not proceed if conifer mortality is expected to exceed 20%. Given the potential for some plantations to not meet suitable burning criteria and the potential for minimal conifer mortality, conifer densities were not adjusted for prescribed fire; therefore, projections of stand density are representative of higher potential conifer densities.

Stand Attributes

Species composition, trees per acre and volume were calculated based on either RCONIFERS outputs or using FVS default equations. Pre-Rim Fire CWHR type, size and density within the project area were determined using CWHR spatial data (CDFW 2014b). The Rim Fire caused significant changes to CWHR classifications, which have not been remapped. Expected changes described in Table 4 of the Rim Recovery Vegetation Report provided the basis for the Rim Recovery project analysis (USDA 2014). For consistency, this analysis is based on the same expected changes. During this analysis, however, some errors in the CWHR pre-fire data were discovered. The errors occurred primarily in the plantations created in the 1990s after the 1987 Stanislaus Complex Fire. Many of the plantations were incorrectly coded as grass or shrub vegetation types because they were either in the process of being prepared for planting or were recently planted when the imagery used for creating the CWHR dataset was created. The differences in the acreages between this analysis and the Rim Recovery analyses are based on corrections by the Forest GIS staff on the CWHR classification in areas with recently discovered errors. Post-fire CWHR vegetation types were assumed to remain unchanged unless active reforestation or natural regeneration occurs. If converted to conifer forest, then it is assumed to be either ponderosa pine (PPN) or Sierran mixed conifer (SMC). CWHR size and density was projected for all analyses in FVS using an AddFile developed by FVS staff (Rebain 2005).

Changes in SDI are evaluated for existing plantations, new plantations and in areas with natural conifer regeneration. SDI was calculated using the equation developed by Reineke (1933) for trees greater than or equal to 1 inch dbh. Long and Shaw (2012) recommend this SDI calculation for mixed conifer stands that are not compositionally “pure” (i.e., greater than 80% of basal area composed of either true firs and Douglas-fir or ponderosa pine and Jeffrey pine). Depending on stand attributes and age, other methods of calculating SDI may be more appropriate. Values of SDI produced using the Reineke (1933) equation are essentially equal to other equations for younger even age-aged stands, but increasingly diverges with increasing skewness of the diameter distribution (Long and Shaw 2012). Therefore, the Reineke (1933) equation is appropriate for calculating SDI for this analysis because plantations and natural regeneration is generally going to be even-aged during the analysis period and basal area rarely composed of a single species.

Thin Existing Plantations

Common stand exam (CSE) data for this analysis was downloaded from the Natural Resources Management Natural Resource Information System (NRM NRIS) Field Sampled Vegetation

Database (FSVeg). All data was collected between 2005 and 2013 (prior to the 2013 Rim Fire). Only plots representing conifer or mixed hardwood-conifer types were used to simulate effects of thinning and growth in existing plantations. All other CWHR vegetation types were assumed unchanged throughout the analysis time frame. CWHR size and density in non-conifer vegetation types are expected to increase over time, but proposed treatments in these types will primarily focus on fuels reduction and not significantly alter tree structure if trees are present. A total of 843 plots located within the Rim Fire perimeter were processed using the Western Sierras variant of FVS (Dixon 2002). Each plot was categorized by CWHR vegetation type based on the relative proportion of conifer and hardwood canopy cover (CDFG 2005). FVS was used to classify each plot according to size and density (Rebain 2005). Plots were then processed together as stands depending on CWHR size and density to represent CWHR classifications that occur in proposed thinning units.

Thinning was simulated in FVS based on the ICO thinning guidelines (2.01 How the Alternatives Were Developed) and CWHR size and density classifications. For size classes 3 and less the ICO thinning guidelines would likely result in an average residual tree density of about 128 trees per acre. Residual tree densities in larger CWHR size classes would be about 105 trees per acre. These distinctions were made based on the assumed current spacing relative to size. For example, the majority of the larger size classes are located in the Granite plantations, which are older than the 1987 Stanislaus Complex plantations. Many of the Granite plantations were thinned prior to the Rim Fire. Target tree spacing was typically about 18 to 20 feet between trees. Conversely, the younger Complex plantations have experienced only minimal pre-commercial thinning and some have never been thinned. Stand exams prior to the Rim Fire showed that tree densities ranged between 200 and 350 trees per acre in these plantations, suggesting that tree spacing was between about 7 by 14 feet to 14 by 14 feet. The ICO thinning guidelines call for creating 6 small clumps and 2 large clumps per acre with individual trees spaced about 25 feet apart. Prescribing these tree spacing guidelines to plantations that have different distances between trees would result in a range of clump footprint sizes despite the clumps having about the same number of trees. For example, if trees are about 20 feet apart, then a clump of 6 trees would have a footprint of about 2,600 square feet. If the trees were closer, then a smaller area would be required to achieve a clump with the same number of trees. If clumps tend to be small in area, then more space would be available for individual trees and result in higher residual tree densities. Based on these guidelines then, smaller CWHR size classes were estimated to have more residual trees per acre after thinning. While prescribed fire is proposed within existing plantations to maintain low fuel levels prior to mechanical operations, burning would not occur unless conditions would allow for target tree densities to be achieved. Follow-up mechanical treatments would likely be necessary to further reduce tree densities and to remove small standing dead trees; therefore, thinning to target residual tree densities was simulated in all existing plantations one year after prescribed fire.

Affected Environment

The project area encompasses 41,933 acres within the Rim Fire perimeter with elevation ranges from about 3,000 to 7,000 feet. Predominant topographic features include steep river canyons, intermittent tributary drainages and broad sloping benches. Elevational differences in river canyons can range from 800 to 1,300 feet in less than half a mile, but such topographic features occur primarily outside project treatment units. Prior to the Rim Fire, forests within the project area consisted of Sierran mixed-conifer, mixed hardwood-conifer and conifer plantations. Other vegetation included annual and perennial grasslands, chaparral and hardwood types.

Historic Forest Structure

Historic forest structure provides a baseline that can be used to help inform forest management decisions regarding reforestation, density management and how forest structure is expected to change over time. While variables such as climate change introduce uncertainty, the past can provide some insight into how forest structure, function and processes might respond to changing environmental conditions. Several historical accounts and reconstructions of historic structure and composition of Sierran mixed-conifer forests exist. These sources describe a wide range of conditions. This variation is evident in the accounts of Sudworth (1900). Sudworth described distinct forest structures within the low to middle elevations on the Stanislaus National Forest. Ponderosa pine was the most abundant conifer in the middle elevations comprising 45 to 55% of most stands and up to 90% of stands at lower elevations. Sugar pine was less common, but still comprised 5 to 25% of the species composition. Incense cedar and white fir typically comprised 20 to 30% and 30 to 40%, respectively. White fir densities were typically highest at elevations between 4,000 to 5,000 feet and much lower and inconsistent at lower elevations. California black oak comprised a much smaller amount in most stands, with the highest proportions (5 to 10% of stands) occurring at low to mid elevations. Sudworth (1900) noted that there were some areas dominated by open conditions with very large (greater than 30 inches dbh), old-growth pine. In contrast, he also noted abundant dense patches of pine regeneration and dense stands of yellow pine 25 to 50 years old; however, frequent fire was noted as continually thinning such stands and often killing most of the regeneration. Lydersen et al. (2013) reconstructed reference forest conditions on the Stanislaus-Tuolumne Experimental Forest. Fire records indicated that the mean fire return interval was about 5 years; however, the last recorded fire occurred 40 years prior to the collection of the 1929 forest mapping data, so fire exclusion may have already become a factor. Lydersen et al. (2013) estimated that 40 years without fire resulted in an increase of tree densities from about 54 to 133 trees per acre. This ingrowth of smaller trees was possible given the presence of mature trees as seed sources and the absence of fire; however, Lydersen et al. (2013) caution that historic small tree densities were likely underestimated due to limitations related to their dataset.

In contemporary mixed-conifer forests with relatively intact fire regimes, Lydersen and North (2012) found high levels of conifer seedlings and saplings (486 to 4,087 per acre). While seedling and sapling density was very high, densities of larger trees ranged from 45 to 134 trees per acre depending on topographic slope position. Collins et al. (2015) evaluated timber transects conducted in 1911 that were located within the Rim Fire perimeter (in the vicinity of Evergreen Road and Peach Growers). These records suggest areas with even lower tree densities (11 to 32 trees per acre) existed. Seedlings and saplings (trees less than 6 inches dbh) were also recorded along these transects, and similar to the findings of Lydersen and North (2012), occurred at significantly higher densities than larger trees (369 to 637 seedlings/saplings per acre, personal communication, Brandon Collins). The large difference in densities of conifer regeneration and established trees suggests that fire, other disturbances and competition significantly regulated the number of small trees that grew to maturity. In a Jeffery pine mixed-conifer forest with a relatively intact fire regime, Minnich et al. (2000) found that 30 to 60% of pole sized trees survived wildfire. Another study found that about 50% of trees less than 8 inches dbh survived fire (Stephens et al. 2008).

While frequent fire likely killed large portions of conifer regeneration, historic accounts of dense 20 to 50 year old pine stands suggest that a fair amount of conifer regeneration escaped wildfire during early stand development (Sudworth 1900). In contrast to studies that attribute increases in small and intermediate sized trees to the introduction of fire exclusion (Collins et al. 2015; Lydersen and North 2012; Lydersen et al. 2013; Minnich et al. 2000), others argue that a dominance of young- and intermediate-aged stands prior to fire exclusion were actually common because they would regenerate following periodic disturbances that caused significant tree mortality (Odion et al. 2014). Baker (2014) asserts that while there were open, park like stands, Sierran mixed-conifer forests were generally dense and prone to high-severity fire. His results suggest that forest openings and areas with relatively low tree density accounted for about 17 to 30% of the area. He contends that these sparsely forested areas are evidence of high-severity fire that occurred because of dense forest conditions. Although his estimate of mean historic tree density (about 119 trees per acre) is within the range suggested by Lydersen and North (2012), Baker (2014) notes that about 16% of the forested area exceeded 162 trees per acre and about 3% had 405 to 3,642 trees per acres, which suggests that there were areas of relatively dense mixed-conifer forest.

In terms of landscape forest structure, there is no clear answer to the question of how much fire-initiated early seral vegetation is desirable or what proportion of the landscape should be in the early seral stage and how large the patches should be (Coppoletta et al. 2015). Some studies have concluded that the effects of long-term fire exclusion, railroad logging and other past management actions are now contributing to an increasing trend in high-severity fire and area burned in forests of the western United States (Miller et al. 2009; Miller and Safford 2012). As a result, it has been suggested that management needs to focus on replacing high-severity fire acres by increasing the acres of low- and moderate-severity fire in low and middle elevation forests like yellow pine and mixed-conifer (Mallek et al. 2013). Additionally, mounting evidence is showing that climate change exacerbates the negative correlation between increasing acres of high-severity fire and decreasing acres of low- and moderate-severity fire (Westerling et al. 2006; Lenihan et al. 2008; Westerling and Bryant 2008; Littell et al. 2009; Lutz et al. 2009). Under the current and predicted climate scenarios, early seral conditions have been predicted to increase on the landscape (Lenihan et al. 2008). Despite this body of evidence, some assert that there is still a large deficit of high-severity fire in Sierran mixed-conifer forests and because of fire suppression, “even doubling of fire would still be far lower than the historic levels” (Odion and Hanson 2013, p. 20). This school of thought views the lack of high-severity fire as a threat to Sierra Nevada forests (Baker 2014; Hanson and Odion 2014; William and Baker 2012). As a result of this deficit, they argue that post-fire vegetation, not impacted by activities such as salvage logging and reforestation, has become increasingly rare and should be protected (DellaSala et al. 2014; Odion and Hanson 2013).

Some methodologies used to reconstruct historic forest structure and how they relate to fire severity have been called into question. Baker (2014) used similar data and methodology as William and Baker (2012) to determine historical forest structure and fire severity extent. Fulé et al. (2014) identified important errors in basic assumptions and methods in William and Baker (2012): the use of tree size distributions to reconstruct past fire severity and extent is not supported by empirical age-size relationships or by studies that directly quantified disturbance history in dry western forests. Fulé et al. (2014) also note that while William and Baker (2012) asserted surprising levels of 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 structure and fire behavior changes. In response to Fulé et al. (2014), William and Baker (2014) defend their methodologies and findings, entrenching the scientific disconnect in conclusions regarding historic forest structure and high-severity fire in western dry forests.

As noted by Fulé et al. (2014), despite reaching very different conclusions about fire behavior and subsequent forest structure, the results of William and Baker (2012) are not substantially different from other studies with regard to forest structure. The same can be said with regard to results of Safford (2013) and Baker (2014). LANDFIRE BpS models provide an estimate of course landscape forest structure that may have occurred historically and is based on both biophysical conditions and current climatic conditions (LANDFIRE 2009). Safford (2013) used the BpS models to estimate landscape forest structure for Sierran mixed-conifer forests. He estimated that 5 to 15% of the landscape was in a mid-seral closed canopy structural class as shown in Table 3.13-3. This range is similar to the estimate made by Baker (2014) for relatively dense conditions (16%) – assuming values presented by Baker (2014) would classify as mid seral. Safford (2013) also estimated 15 to 20% of the landscape was in an early seral condition, which overlaps with the Baker (2014) estimate of 17 to 30% for forest openings and scattered trees. This difference in the early seral successional class is likely a result of methodologies and interpretations regarding the historic occurrence of high-severity fire. The LANDFIRE BpS models used by Safford (2013) provide a general range of conditions that are within range or close to estimates made in other studies of reference conditions and historical accounts (Franklin and Fites-Kaufman 1996; Bonnicksen and Stone 1982; Show and Kotok 1924).

Pre-Fire Vegetation

LANDSCAPE FOREST STRUCTURE

Table 3.13-5 shows the following CALVEG cover types comprised the majority of the vegetation impacted by the Rim Fire: conifer and mixed hardwood-conifer. Other vegetation cover types included hardwood, shrub, herbaceous, barren and other non-vegetation types.

Table 3.13-5 CALVEG Cover Types within Rim Fire Perimeter, Stanislaus and Project Area

CALVEG Cover Type	Rim Fire Perimeter	Stanislaus National Forest	Rim Reforestation
CON - conifer	138,249	75,042	29,179
MIX - mixed hardwood-conifer	44,078	27,576	7,466
HDW - hardwood	30,756	22,055	1,473
SHB - shrub	27,448	22,724	3,260
HEB - herbaceous	14,267	6,141	533
OTHER - barren, urban, water	2,515	991	22
Total (acres)	**257,314**	**154,530**	**41,933**

Table 3.13-5 shows hardwood, shrub and herbaceous types accounted for about 30% of vegetation depending on the scale. Barren and non-vegetation types accounted for less than 1% of the total Rim Fire footprint. Although the Rim Fire impacted non-conifer cover types, they are expected to maintain relatively the same CWHR type despite fire severity and changes that might occur in CWHR size and density.

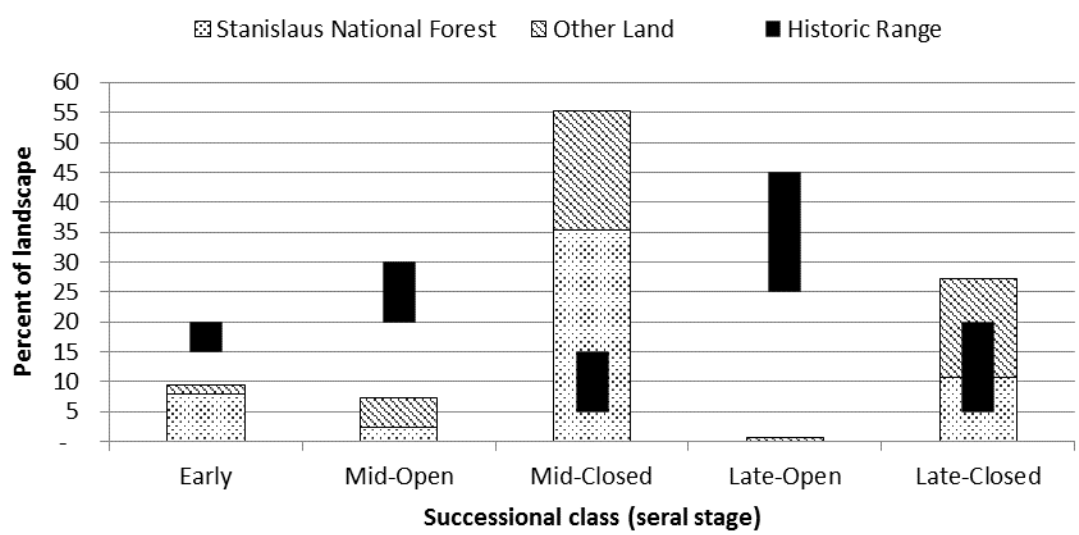

Figure 3.13-1 Average Landscape Forest Structure before Rim Fire Compared to Historic Conditions

CALVEG cover types provide a general classification of what the dominate vegetation is. Within each cover type, some portions of non-conifer CWHR vegetation types may exist. For example, a conifer cover type might encompass both CWHR conifer types as well as CWHR shrub and hardwood types. As noted by Safford (2013), shrub cover occurring within the conifer biophysical setting is considered an early seral structure. Therefore, pre-fire landscape forest structure was estimated for CALVEG conifer and mixed hardwood-conifer cover types because they most closely resemble the LANDFIRE biophysical settings used by Safford (2013) to classify landscape structure of Sierran mixed-conifer forests. Within these two cover types, CWHR vegetation type, size and density was used to classify seral structural classes in Table 3.13-3. Compared to Safford's (2013) estimates of landscape forest structure, Figure 3.13-1 shows a deficit of the following structural classes prior to the Rim Fire, regardless of land ownership: early, mid seral open canopy and late seral open canopy. As a result, there was an excess of mid and late seral closed canopy. The majority of the excess closed canopy was in the mid-seral size class with more than 3 times the historic estimate across all lands and just over 2 times the historic estimate on NFS lands.

California Wildlife Habitat Relationships

Vegetation within the Rim Reforestation project area was primarily conifer or mixed hardwood-conifer (36,645 acres). Other general cover types (e.g., shrub, hardwood and herbaceous) were omitted as to not overestimate the proportion of early seral conditions within the conifer and mixed-hardwood conifer cover types. Table 3.13-6 summarizes the CWHR vegetation type, size and density within these two conifer cover types within the project area. Tables 3.13-1 and 3.13-2 show the size and density class definitions. Ponderosa pine and Sierran mixed conifer were the dominant vegetation types, comprising just over 78% of the vegetation within the project area. The majority of the forest structure was also closed canopy (73%) with only 3.8% in a mid-seral open canopy condition. About 23% was dominated by early seral conditions: shrub (2,336 acres), grass (1,856 acres), and tree seedlings and saplings (4,333 acres). This proportion of early seral conditions slightly exceeded the estimated historic proportion for early seral conditions (15 to 20%, Safford 2013).

Table 3.13-6 Acres by Pre-Rim Fire CWHR Vegetation Type, Tree Size, Canopy and Seral Stage

Successional Class (Seral Stage)	**Size and Density**	**Shrub and Grass**	**MHW**[1]	**BOP**	**MHC**	**JPN**	**LPN**	**PPN**	**SMC**	**WFR**	**Total**
Early	1 and 2, all densities	4,192	52	3	118		5	3,607	548		8,525
Mid-Open	3S	3			8			91	48		150
Mid-Open	3P		3	2	43		4	413	431		898
Mid-Open	4S			1		2		20	31		53
Mid-Open	4P				6	2	6	113	188	5	320
Mid-Closed	3M			10	163		21	1,095	666		1,954
Mid-Closed	3D		70	3	155	8	41	1,130	328		1,735
Mid-Closed	4M			24	214		26	1,209	1,445	3	2,922
Mid-Closed	4D		61	35	2,193	3	33	4,788	9,172	11	16,296
Late-Closed	5M								15		15
Late-Closed	5D		53		217		129	313	3,065		3,777
	Total	**4,195**	**239**	**77**	**3,117**	**14**	**266**	**12,778**	**15,938**	**19**	**36,645**
	% of Total	**11.4**	**0.7**	**0.2**	**8.5**	**0.04**	**0.7**	**34.9**	**43.5**	**0.1**	**100.0**

[1] MHW=montane hardwood; BOP=blue oak-foothill pine; MHC=montane hardwood-conifer; JPN=Jeffrey pine; LPN=lodgepole pine; PPN=ponderosa pine; SMC=Sierran mixed conifer; WFR=white fir. All within CALVEG cover types conifer and mixed-hardwood conifer

Areas Proposed for Reforestation

At most, the total area proposed for reforestation is 26,009 acres (includes natural regeneration and deer habitat enhancement units). Dispersed throughout the proposed reforestation units were patches of the following general CALVEG cover types: hardwood (691 acres), shrub (1,722 acres), herbaceous (85 acres) and other non-vegetation cover types (19 acres) that add up to 2,517 acres. About 93% of the area proposed for reforestation was classified as CALVEG cover types conifer or mixed hardwood-conifer. Of the conifer and mixed hardwood-conifer cover types, 81% was classified as CWHR type ponderosa pine or Sierran mixed-conifer and 12% was classified as other conifer or montane hardwood-conifer types. Less than 1% was classified as montane hardwood and about 6% was classified as shrub or grass CWHR grass types. In total, there was 2,705 acres (12% of the conifer and mixed-hardwood CALVEG cover types) of early seral structure.

Existing Plantations Proposed for Thinning

Within the Rim Fire perimeter an estimated 17,773 acres of plantations were predominately planted after the 1973 Granite Fire, 1987 Stanislaus Complex Fire and 1996 Rogge Fire. All of these plantations are included in the Rim Reforestation project. A portion of these plantations were classified as hardwood (664 acres), shrub (1,880 acres), herbaceous (144 acres) and other non-vegetation (3 acres) CALVEG cover types. These non-conifer cover types are primarily small patches of distinct vegetation dispersed throughout the plantations. Of the 15,082 acres of conifer and mixed hardwood-conifer cover types, 134 acres were classified as late seral ponderosa pine and Sierran mixed-conifer forest (CWHR size class 5). These late seral conditions were also scattered throughout the existing plantations and were likely small remnant patches that escaped the previous fires.

Rim Fire

The Rim Fire caused extensive vegetative changes. High severity patches were uncharacteristically large and accounted for a larger proportion (35%) of the burned area than historically occurred (Miller et al. 2009). Other areas of low or very low severity continue to have intact forest tree cover, but are experiencing increasing levels of insect- and drought-related tree mortality due to sustained drought conditions (USDA 2015d).

Several factors contributed to the pattern of severity and fire effects: extreme drought, fire weather, years since last fire, elevation and topography, shrub cover, tree species composition and surface fuels (Harris and Taylor 2015; Lydersen et al. 2014; Kane et al. 2015). Historically, these same factors, with the exception of extreme drought, are believed to have resulted in a self-regulating system of interactions between vegetation characteristics and disturbance (North et al. 2009; Lydersen et al. 2012; Harris and Taylor 2015). However, the effects of fire exclusion and drought have altered forest structure and created burn conditions that resulted in historically novel fire effects during the Rim Fire. Both Harris and Taylor (2015) and Lydersen et al. (2014) found that study plots with a greater proportion of shade-tolerant tree species and higher densities of small and intermediate sized trees (conditions often associated with high fire severity), generally burned with lower fire severity. Lydersen et al. (2014) found that elevation and shrub cover contributed the most to high-severity fire. Their study plots with higher shrub cover were primarily those at lower elevations with lower tree densities, whereas the plots with less shrub cover were those at higher elevations with higher tree densities and more white fir. The plots at higher elevations were cooler and moister, which contributed to greater tree canopy cover. Harris and Taylor (2015) reported similar results, finding that fire severity was associated with shrub cover and topographic position. Shrub cover was associated with pine on dry upper slopes and ridges, whereas lower slopes and valley bottoms supported higher densities of trees with cooler temperatures and higher moisture levels. Given the relatively mild fire weather, Harris and Taylor (2015) conclude that cool, moist areas escaped high-severity fire despite higher densities of shade-tolerant species.

Kane et al. (2015) also conducted a study that evaluated biophysical factors of the Rim area. Unlike Lydersen et al. (2014) and Harris and Taylor (2015), this study found that areas associated with greater moisture and productivity actually contributed to the uncharacteristically large high severity burn patches of the Rim Fire. These contrasting findings are likely a result of scale. Kane et al. (2015) explain that larger scales represented by their biophysical predictors “may simply better match the scales at which fire behavior, the biophysical environment, and fuel variations correlate” (p. 70). Kane et al. (2015) compared the fire effects of the Rim Fire to previous fires in the study area using actual evapotranspiration, which is an indicator of productivity. Greater evapotranspiration infers greater productivity, which is associated with moist conditions. Compared to the Rim Fire, previous fires in the study area experienced significantly lower proportions of high severity fire. For pre-Rim fires, actual evapotranspiration was negatively correlated with burn severity. That is, moist and productive sites experienced lower burn severities. In the Rim Fire, however, this trend reversed and actual evapotranspiration correlated with higher burn severities. Kane et al. (2015) attribute this “flip” to the drought drying locations that usually had higher fuel moistures, and the Rim Fire then burned the fuel accumulations that had built up in these areas. An example of such an area is Corral Creek, which is a highly productive site that had a high proportion of mature Douglas-fir, incense cedar and white fir prior to the fire. The most productive areas of Corral Creek were the lower slopes and valley bottoms. Tree heights approached and exceeded 200 feet. Numerous trees exceeded 30 inches dbh and the largest trees exceeded 50 inches dbh. Both the 1987 Stanislaus Complex Fire and the 1996 Rogge Fire burned near this area. The cool moist conditions likely contributed to the area experiencing little disturbance during previous fires; however, Corral Creek experienced 100% tree mortality during the Rim Fire.

Existing Conditions

LANDSCAPE FOREST STRUCTURE

After the Rim Fire, RAVG analysis mapping was completed to assess burn severity and change in vegetation. CWHR habitat classifications were adjusted based on the RAVG burn severity mapping. Figure 3.13-2 summarizes the post-fire landscape forest structure for the entire Rim Fire footprint compared to historic reference conditions (Safford 2013). Both the mid and late seral open canopy successional classes slightly increased, but are still far less than historic ranges. Mid and late seral closed canopy successional classes experienced large decreases. Late seral closed canopy was reduced to just within the historic range across all lands. When considering only NFS lands, late seral closed canopy conditions are slightly greater than the historic minimum; however, there is still an excess of mid seral closed canopy conditions on NFS lands.

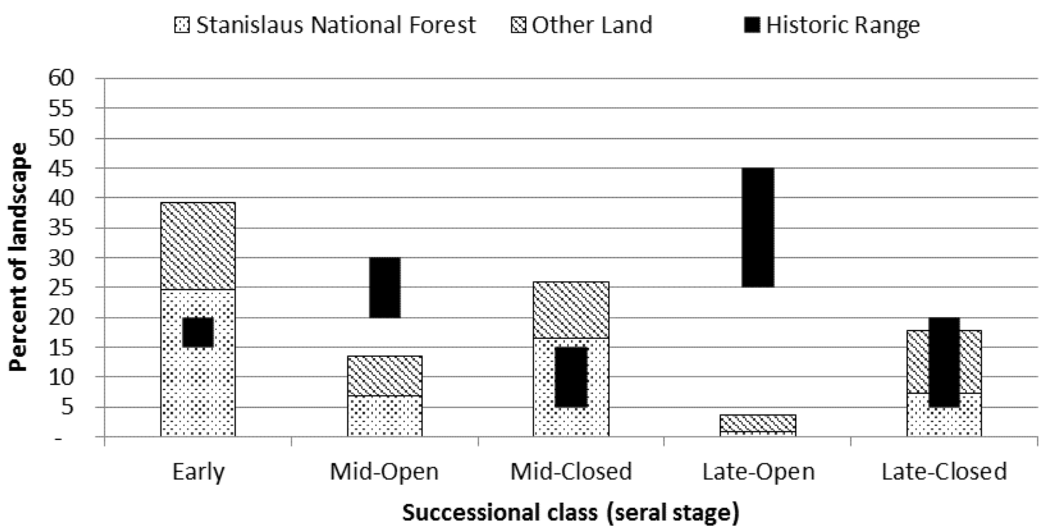

Figure 3.13-2 Average Landscape Forest Structure after Rim Fire Compared to Historic Conditions

Across the entire Rim Fire landscape, almost twice as many acres of mid seral closed canopy conditions exist than the historic range. Given the uncharacteristically large proportion of the landscape that experienced high severity fire, a large portion of the closed canopy conditions were shifted to the early seral successional class. Across all lands, an excess of nearly twice as much early seral conditions, almost 40% or 71,552 acres, now exists compared to the historic maximum of 20%. The majority of the early seral successional structure is on NFS lands (44,975 acres) and consists mostly of mixed chaparral and montane chaparral (36,870 acres). Early seral structure on NFS lands (almost 25%) exceeds the historic range of 15 to 20%. Non-NFS lands are just within the historic range (about 15%).

Complex Early Seral Forest

Immediately after the Rim Fire, timber salvage was conducted primarily in large patches of severely burned areas (USDA 2014). In many of these areas salvage operations have either been completed or are currently underway. Hazard tree removal has also been conducted along many forest roads and near structures. However, a considerable amount of acres were moderately or severely burned during the Rim Fire that have not been impacted by salvage or hazard tree operations. The term complex early seral has been defined by some as early seral conditions created by stand replacing disturbances that have not otherwise been altered by humans (DellaSala et al. 2014; Odion and Hanson 2014). That is, no standing dead trees are removed and post-fire vegetation is allowed to develop without human intervention. Stand-replacing events that kill all or most of the dominant trees therein, typically leave behind many biological legacies (e.g., standing dead trees and large down woody debris) that create distinct differences compared to pre-disturbance conditions (Swanson et al. 2011).

Figure 3.13-3 Retention of Standing Dead Trees during Salvage in Femmons Meadow Area

For this analysis, complex early seral forest was defined as all CWHR type, size and density classes within CALVEG conifer and mixed hardwood-conifer cover types that experienced at least 50% basal area mortality and were not impacted by the Rim Recovery project, Rim HT project, or were not located on private lands (i.e., assumed salvage operations conducted on all private lands). Once the Rim Recovery and Rim HT projects are fully completed, a minimum of 41,875 acres of complex early seral forest would remain within the Rim Fire perimeter, of which 19,971 acres is on NFS lands. Based on the definition of seral structural classes defined by Safford (2013), a portion of these complex early seral acres (7,376 acres; 2,808 acres on NFS lands) could be considered mid or late seral open canopy structure because they experienced moderate-severity fire and still have low densities of surviving trees; however, the vast majority of these acres (34,499 acres total; 17,163 acres on NFS lands) resulted from high-severity fire that killed virtually all trees and now make up 48% of the current early seral structure across the Rim Fire landscape (Figure 3.13-2). In other words, almost half of the 71,552 acres of early seral conifer and mixed hardwood-conifer structure within the Rim Fire landscape has not been altered by humans. Based on Safford's (2013) estimate of the proportion of early seral structure, the current amount of complex early seral forest (34,499 acres) nearly equals the historic maximum of 20% of the conifer and mixed-conifer forest within the Rim Fire landscape.

Although salvage and hazard tree operations removed standing dead trees, the Rim Fire Recovery project (USDA 2014) required that 4 to 6 of the largest trees per acre with a dbh of at least 24 inches be retained for wildlife purposes. When considering the diversity of historic tree density and the range of fire severities, an equivalent range of standing dead tree densities likely occurred historically. Dense forest conditions likely resulted in larger numbers of standing dead trees following high severity fire. Conversely, areas with lower tree densities may have resulted in lower numbers of dead standing trees. Collins et al. (2015) determined that large tracks of very low overstory tree densities (11 to 32 trees per acre) existed on the Stanislaus. With such low tree densities, it was likely that areas with only small patches of standing dead trees existed, especially following mixed severity fire conditions. Therefore, the areas that were salvage logged after the Rim Fire still provide some elements of structural complexity despite the effects of mechanical operations. Figure 3.13-3 shows retention of standing dead trees in an area recently salvaged near Femmons Meadow.

Table 3.13-7 Acres by Post-Rim Fire CWHR Vegetation Type, Tree Size, Canopy and Seral Stage

Successional Class (Seral Stage)	Size and Density	Shrub and Grass	MHW[1]	BOP	MHC	JPN	LPN	PPN	SMC	WFR	Total
Early	1 and 2, all densities	22,819	226	61	64			2,253	402		25,826
Mid-Open	3S	3	1	3	38		6	270	243		563
Mid-Open	3P		4	1	39	1	3	306	299		652
Mid-Open	4S			1	151		7	407	917	3	1,486
Mid-Open	4P		7	8	142		3	480	952	5	1,597
Mid-Closed	3M				18		6	299	192		516
Mid-Closed	3D		1		19	2	2	326	60		410
Mid-Closed	4M				42		2	511	465	2	1,023
Mid-Closed	4D		3	4	263			1,450	1,670	3	3,392
Late-Open	5S				14		9	18	237		277
Late-Open	5P				13		5	22	242		281
Late-Closed	5M								1		1
Late-Closed	5D				19		4	36	562		621
	Total	**22,822**	**241**	**77**	**822**	**3**	**48**	**6,375**	**6,242**	**13**	**36,645**
	% of Total	**62.3**	**0.7**	**0.2**	**2.2**	**0.01**	**0.1**	**17.4**	**17.0**	**0.04**	**100.0**

[1] MHW=montane hardwood; BOP=blue oak-foothill pine; MHC=montane hardwood-conifer; JPN=Jeffrey pine; LPN=lodgepole pine; PPN=ponderosa pine; SMC=Sierran mixed conifer; WFR=white fir. All within CALVEG cover types of conifer and mixed-hardwood conifer

CALIFORNIA WILDLIFE HABITAT RELATIONSHIPS

Table 3.13-7 summarizes the post-Rim Fire CWHR vegetation type, size and density classifications within CALVEG conifer and mixed hardwood-conifer cover types. Large wildfires that have high proportions of high severity fire can convert large areas of conifer forest to shrub vegetation (Collins and Roller 2013; Crotteau et al. 2013; Coppeletta et al. 2015; Nagel and Taylor 2005). The Rim Fire shifted a large portion of the project area into an early seral structure, increasing the abundance of grass and shrub vegetation types from about 11% to over 62% of the project area. Early seral conditions now comprise a significantly larger proportion of the project area compared to historic Sierran mixed-conifer landscapes (15 to 20%, Safford 2013). As a result, the proportion of ponderosa pine and Sierran mixed-conifer vegetation types was significantly reduced from 78% to less than 35% of the project area. Areas of low- to moderate-burn severity slightly increased the proportion of mid and late seral open canopy conditions.

Areas Proposed for Reforestation

The 2,517 acres of non-conifer CALVEG cover types did not significantly change despite high-severity effects during the Rim Fire. The hardwood types likely experienced high tree mortality in some areas, but hardwood species in the project area readily sprout after fire and quickly regain dominance over the site. Within CALVEG cover types conifer and mixed hardwood-conifer (23,492 acres), the Rim Fire significantly reduced the proportion of conifer-dominated CWHR vegetation types. Prior to the fire, conifer types comprised 93% of the vegetation, but now comprise about 20%. Much of the conifer vegetation was shifted to an early seral structure (18,479 acres), mostly consisting of mixed chaparral and montane chaparral (17,375 acres). Patches of mid and late seral conifer forest totaling 5,013 acres are distributed throughout the areas proposed for reforestation. Just over half of these acres (2,857) experienced moderate burn severity and are now in an open canopy condition with scattered conifers. The majority of these patches were incidentally included when drawing boundaries using GIS and account for small portions of units. They are also typically located within close proximity to the edge of high-severity burn patches. Stress caused by the Rim Fire (e.g., crown scorch and severe cambium heating) in addition to extended drought conditions and amplified bark beetle activity has increased levels of tree mortality reducing tree densities or in some cases resulting in 100% mortality. The majority of natural conifer regeneration, as discussed in the following sections, has been observed within close proximity of residual live trees and high-severity patch edges. These areas primarily account for the proposed natural regeneration units (2.02 Alternatives Considered in Detail). For the purpose of this analysis, natural regeneration units are analyzed for active reforestation to account for the scenario of greatest potential impact. The 2,517 acres classified as non-conifer vegetation are areas that would be excluded from reforestation activities (e.g., dense oak patches, stringer meadows, lava caps and roads). These areas contribute to the diversity of vegetation and cover across the landscape, but are not included in calculations of landscape forest structure classes (seral stages) within conifer and mixed hardwood-conifer cover types. While discussions of effects may refer to all 26,009 acres proposed for reforestation, it is with the understanding that these non-conifer cover types would not be planted.

Existing Plantations Proposed for Thinning and Prescribed Fire

Overall, the Rim Fire burned with high burn severity across 98,049 acres (USDA 2014e). Despite the uncharacteristically large area of high burn severity, only a small portion of these acres can be attributed to plantations. Of the 17,773 acres of existing plantations, 9,919 acres (56%) experienced less than 50% basal area mortality. An additional 4,015 acres of plantations experienced a mix of burn severities, which left patches of dense plantations among patches of moderate to high burn severity patches. Together, these plantations compose the 13,934 acres (78% of existing plantations) that are proposed for thinning under the Rim Reforestation project.

Several factors likely contributed to the variation of burn severities in the existing plantations. Plantations are often considered to be vulnerable to wildfire because young conifers have thin bark and low branches that are sensitive to scorching (McGinnis 2010). Studies of the Rim Fire, however, have also shown that biophysical conditions and shrub cover seemed to play an important role in fire severity, more so than tree size and density (Lydersen et al. 2014; Harris and Taylor 2015). Similarly, an evaluation of the Granite plantations determined that the biggest risk to plantations are surface and ladder fuels; and therefore, plantations that have an overall continuity of surface fuels are more likely to support large severe fires as opposed to well established plantations with trees that have grown to heights providing distinct separation of surface litter fuels and the canopy, as well as successfully shading the forest floor and minimizing shrub cover continuity (Sapsis and Brandow 1997).

About one third of the plantations proposed for thinning were planted after the 1996 Rogge Fire. Tree sizes in these plantations currently range between 3 and 6 inches dbh with heights between 15 and 20 feet. These plantations were predominately planted at a density of 444 trees per acre. As previously noted, third year survival exams indicate that deep tilling and herbicide treatments result in about

25% mortality during the first few years of tree establishment. As a result, current tree density in these plantations averaged about 325 trees per acre prior to the fire; however, post-fire live tree density is somewhat lower in areas that experienced low- to moderate-severity fire (220 to 300 trees per acre). While some areas experienced higher severity fire, there are still patches with tree densities exceeding 300 trees per acre.

The next oldest plantations were established after the 1987 Stanislaus Complex Fire during the 1990s and also account for about one third of the plantations proposed for thinning. These plantations were planted using similar methods and planting densities as the Rogge plantations; therefore, post-fire tree densities are similar. Because these plantations are almost 10 years older, however, diameters and heights are larger on average. Tree diameters typically range from about 6 to 12 inches dbh with heights of 25 to 35 feet.

The oldest plantations were planted after the Granite fire in the 1970s. Many of these plantations had been thinned prior to the Rim Fire. On average, tree spacing ranges from 16 to 22 feet (about 135 trees per acre post-fire). Tree diameters are considerably larger than many of the Rogge or Complex plantations, ranging from 12 to 18 inches on average with heights of 50 to 70 feet.

Deer habitat enhancement using prescribed fire only is proposed on 1,990 acres. The Jawbone lava cap comprises the majority of these acres (50%). The remainder is a mix of Rogge plantations and hardwood vegetation that experienced a mix of low-, moderate-, and high-severity fire.

NATURAL REGENERATION

The correlation between natural conifer regeneration and the Composite Burn Index (CBI) within areas proposed for reforestation is similar to the findings of Crotteau et al. (2013). The highest conifer seedling densities are in the low- and moderate-severity burn patches. Seedling density in high-severity burn areas is the lowest and most inconsistent as shown in Table 3.13-8. The proportion of plots without conifer regeneration in high-severity burn areas is 71%, which is about twice as much as the low- and moderate-burn severities. Other studies of conifer regeneration and burn severity have observed a similar trend (Collins and Roller 2013). When extrapolated to acres, the total area within proposed reforestation units with and without natural conifer regeneration is estimated at 9,825 acres and 16,184 acres, respectively. These estimates are based on the proportion of null plots vs. stocked plots in the project area, making them rough approximations. While the actual stocked acres likely vary, the large number of plots completed provide a reasonable baseline for estimating the proportion of the project area with substantial conifer regeneration that has the potential to qualify as conifer cover according to CWHR standards (i.e., at least 10 to 25% conifer cover). The large number of plots also provide a statistically reliable estimate of conifer density and species composition to within at least six seedlings per acre based on an alpha level of 0.1. Although it is difficult to quantify and describe the spatial distribution of natural regeneration based on plot data, the increasingly higher number of null plots in the more severely burned areas suggests a greater proportion of these areas have little to no natural conifer regeneration compared to areas that experienced lower burn severities. The overall average seedling density within each burn severity is shown in Table 3.13-8. Because natural conifer regeneration is typically non-uniform and occurs in clumps, the average seedling density calculated using only stocked plots is also shown. The average based on stocked plots is intended to provide a frame of reference in terms of conifer densities occurring in clumps as opposed to an overall average density that gives an inaccurate picture of uniformly distributed regeneration. Despite the majority of the areas proposed for reforestation experiencing high-severity fire, small patches of low-severity fire are distributed throughout treatment units. Many of these patches were included incidentally when delineating unit boundaries in ArcMap and would obviously not require reforestation.

White fir seedlings are more abundant than any other species; likely because it is a prolific seeder (Zald et al. 2008). It comprises about 50% of the natural conifer regeneration across most burn severities. Douglas-fir is the second most abundant and comprises about 25% of the conifer regeneration consistently across all burn severities. Pine species are the most abundant in unchanged areas and overall much lower in density compared to white fir and Douglas-fir. All pine species combined only account for about 13% of natural conifer regeneration. Ponderosa pine is the most common pine species, accounting for 11% while sugar pine contributes only about 1% and other pine species (grey pine, knobcone and Jeffrey pine) account for less than 1%. Some seedlings were unable to be identified, but only amounted to about 4% of all conifer regeneration.

Although plots were not visited both pre- and post-salvage logging, a large portion of the plots were completed in areas that were expected to be salvaged. This plot data suggests that salvage and fuels reduction operations that have occurred in the project area have reduced conifer regeneration density by 72% and oak regeneration by 26%. While mechanical operations reduced conifer seedling density, it minimally impacted the proportion of null plots. When comparing logged to unlogged plots, less than a 4% difference exists in the proportion of plots with no conifer seedlings. Table 3.13-8 summarizes logged and unlogged plots together as well as separately, showing the existing conditions of conifer regeneration at the time surveys were completed. Unlogged plots were adjusted accordingly in the growth modeling to account for scheduled salvage and fuels operations. Although oak and other hardwood regeneration has been impacted by mechanical operations, it is still quite abundant across all burn severities because of its ability to sprout from stumps and roots. Hardwood regeneration density across the areas proposed for reforestation averages about 70 seedlings or sprouts per acre, about 78% from stump and root sprouts. A disproportionate abundance of California black oak (80%) is regenerating compared to other hardwood species. Canyon live oak is the second most abundant (17%), while other hardwood species (interior live oak, blue oak, big leaf maple, dogwood, willow and alder) account for only about 3% of regenerating hardwoods.

Table 3.13-8 Natural Conifer Regeneration within Areas Proposed for Reforestation

Burn Severity (CBI) **and Condition**	**Total Acres**[1]	**Total Plots**	**Null Plots**	**Percent Null Plots**	**Average Seedlings Per Acre**		**WF** (%)	**IC** (%)	**DF** (%)	**PINE** (%)	**UNK** (%)
					All Plots	**Stocked Plots**[2]					
Unchanged: logged	30	2	0	0	2,925	2,925	40	34	14	12	0
Unchanged: unlogged	209	14	3	21	1,779	2,264	16	22	31	32	0
Unchanged: subtotal	**239**	**16**	**3**	**19**	**1,922**	**2,365**	**20**	**24**	**27**	**28**	**0**
Low: logged	96	4	0	0	2,575	2,575	52	0	0	48	0
Low: unlogged	1,275	53	9	17	4,967	5,983	52	6	18	11	14
Low: subtotal	**1,371**	**57**	**9**	**16**	**4,804**	**5,705**	**52**	**6**	**17**	**12**	**13**
Moderate: logged	1,496	83	35	42	881	1,524	8	23	44	23	3
Moderate: unlogged	4,193	237	89	38	3,134	5,019	59	4	27	8	2
Moderate: subtotal	**5,662**	**320**	**124**	**39**	**2,553**	**4,168**	**54**	**5**	**29**	**9**	**2**
High: logged	5,343	365	260	71	126	437	26	2	30	40	3
High: unlogged	13,393	915	645	71	304	1,031	51	1	24	19	4
High: subtotal	**18,736**	**1,280**	**905**	**71**	**255**	**870**	**48**	**1**	**25**	**22**	**4**
Total: logged	7,058	545	295	65	298	850	19	14	34	30	2
Total: unlogged	18,951	1,219	746	61	1,074	2,768	55	4	25	11	5
Grand Total	**26,009**	**1,673**	**1,041**	**62**	**865**	**2,291**	**52**	**5**	**26**	**13**	**5**

CBI=Composite Burn Index; WF=white fir; IC=incense cedar; DF=Douglas-fir; PINE=ponderosa pine, Jeffrey pine, sugar pine, grey pine and knobcone pine; UNK=unknown conifer

[1] Acres include deer reforestation units and natural regeneration units. Logged and unlogged acres calculated based on number of plots with evidence of logging activity.

[2] Calculated using only plots with natural conifer regeneration.

Many factors, such as available moisture, soil insolation and rodent herbivory, influence post-fire seedling establishment (Crotteau et al. 2013; Nathan et al. 2002; Saigo 1969; Vander Wall et al. 2005), but the foremost requirement for natural conifer regeneration is seed source (Bonnet et al. 2005). Shatford et al. (2007) found that distance to seed source for Douglas-fir and white fir was not necessarily a limiting factor; however, pine species have heavier seed (Laacke 1990; Oliver and

Ryker 1990), which likely decreases the rate of long-distance seed dispersal. While regeneration tends to be highest in low to moderate severity patches (Crotteau et al. 2013), Bonnet et al. (2005) found that seedling establishment was very successful in patches of high-severity that were within about 40 feet of unburned forest canopy, but decreased exponentially toward the center of burn patches. Distance to nearest potential seed source was recorded during surveys in the Rim Fire area.

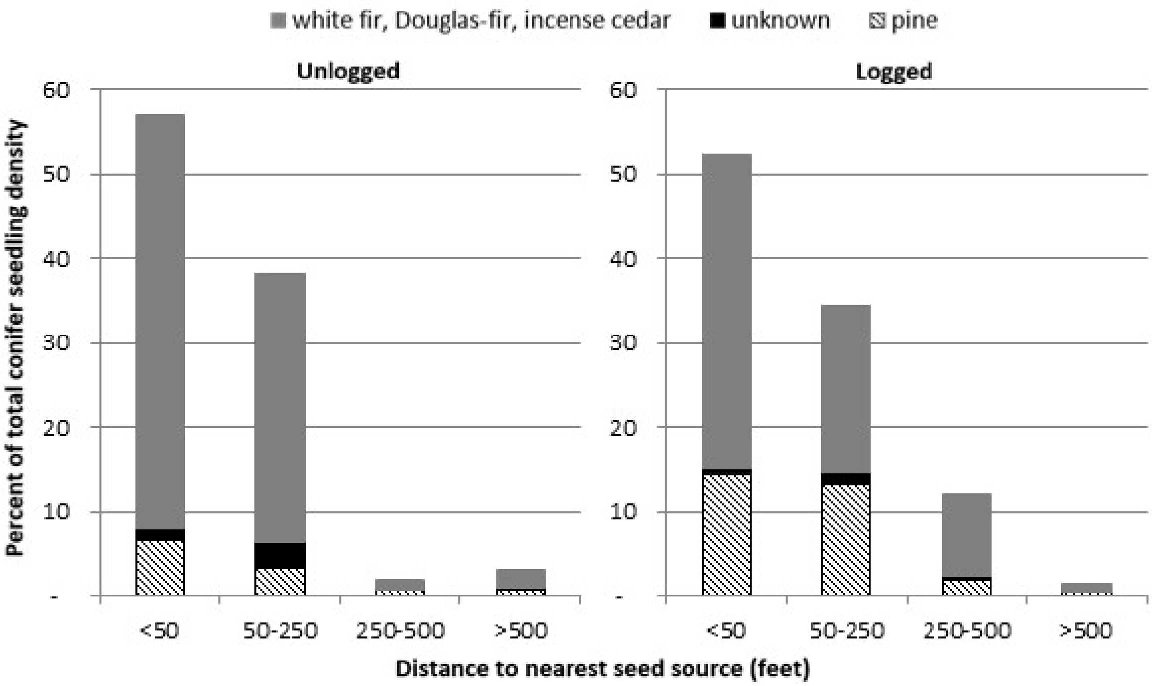

Figure 3.13-4 Distribution of Natural Conifer Regeneration within Areas Proposed for Reforestation

Figure 3.13-4 summarizes the density of natural conifer regeneration within units proposed for reforestation and shows the difference between logged and unlogged plots. The largest proportion of seedlings is within 50 feet of live mature conifer trees. The proportion of natural conifer regeneration sharply declines as the distance to live mature conifers increases. This trend is true for all conifer species. White fir, Douglas-fir and incense cedar comprise 71% and 68% of the conifer regeneration occurring at distances of 250 to 500 feet and greater than 500 feet from live trees, respectively.

UNDERSTORY VEGETATION

The relationship between shrub cover and burn severity followed general trends observed after other large wildfires (Collins and Roller 2013; Coppoletta et al. 2015; Crotteau et al. 2013). Overall cover of shrubs, grasses and forbs has a positive correlation with burn severity. Within unchanged, low-, moderate- and high-severity areas vegetation cover averages 4%, 23%, 50% and 61%, respectively. Grasses and forbs make up about 25% of the vegetative cover in both moderate- and high-burn severity. Bearclover and deerbrush are disproportionately more abundant than any other shrub species across all burn severities; however, moderate-severity has a more even distribution of species than high-severity. In moderate-severity, bearclover and deerbrush each comprise about one fifth of the vegetation (on average about 9% cover). In high-severity, bearclover accounts for about one third (20%) of the vegetative cover and deerbrush one sixth (10%). Bearclover has an extensive system of below-ground rhizomes and tap roots that aggressively respond to above ground disturbances such as fire (McDonald et al. 2004). In addition to effectively sprouting after disturbances, *Ceanothus* species (such as deerbrush, whitethorn, and buckbrush) commonly store more seed in the soil than other shrub species (Knapp et al. 2012), which has likely contributed to the high abundance of deerbrush in the project area. The majority of the plots that were dominated by deerbrush occurred in drainages, while mid-slopes, ridges and emergency travel routes were typically dominated by bearclover.

Manzanita species are the third most abundant shrub species. Knapp et al. (2012) found that after ceanothus species, manzanita was the next most abundant shrub seed stored in mixed-conifer forest soil. Numerous other shrub species exist throughout the project area including, but not limited to cherry, ribes, toyon and poison oak. Manzanita and these species individually account for less than 1% of the total vegetative cover, but where present species like manzanita and buckbrush can occur in large dense patches. Overall, other shrub species account for a much smaller portion of the total vegetative cover compared to bearclover or deerbrush.

Environmental Consequences

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Tree Size and Species Composition

Reforestation

Reforestation efforts, including site preparation and release, plant seedlings and take advantage of natural regeneration resulting in predictable conifer survival and growth (Fiske 1981). Artificial regeneration allows for more control over competing vegetation and tree species composition. Ground disturbing activities (such as fire, tractor piling, hand cutting and shredding) during site preparation can stimulate sprouting of several shrub species (e.g., bearclover, *Ceanothus* species and some species of manzanita). Similarly, these activities can stimulate germination of shrub seeds stored in the soil, making control of competing vegetation challenging (Knapp et al. 2012).

Deep Tilling and Forest Cultivation

Areas site prepped with deep tilling and forest cultivation would have better survival than those areas not tilled. Deep tilling kills above-ground portions of shrubs and breaks-up below-ground roots and rhizomes (McDonald et al. 2004), which reduces initial competition for water during the first growing season after planting. As displayed in Table 3.13-4, initial conifer survival is estimated at about 75% in areas prepped with deep tilling and followed up with herbicide releases. Reduced competition would also increase conifer growth.

Herbicides

Herbicide site preparation and release treatments would effectively reduce shrub and grass competition for the first five years allowing establishment and development of conifers in a free to grow environment. Initial herbicide release treatments would require the most widespread application because shrubs and other herbaceous vegetation would have relatively high cover. These first treatments would kill both above- and below-ground portions of shrubs and other understory vegetation, reducing their abundance. Each subsequent treatment would likely require less herbicide be dispensed to achieve desired levels of competing vegetation (i.e., less than 10,000 cubic feet per acre, USDA 2010a). Areas that are deep tilled would also require less herbicides be applied to effectively control competing vegetation.

The beneficial effects of herbicide release treatments on understory vegetation would likely last several years after release treatments stop, resulting in reduced abundance of shrubs, grasses and forbs. Experience on the Stanislaus National Forest as well as documented research, have shown understory vegetation does recover even after multiple herbicide applications (DiTomaso et al. 1997; McDonald and Fiddler 2010; Sapsis and Brandow 1997). Given the abundance of seed stored in the soil and numerous areas excluded from herbicide application (e.g., oak buffers, sensitive areas, riparian buffers, heritage exclusions), the diversity of understory plant communities are not at risk of being lost from the project area and can effectively recover and spread throughout treatment areas over time. Figure 3.13-5 shows bearclover and manzanita growing in 15-year old plantations where both deep tilling and herbicides were used after the 1996 Rogge Fire. Increases in herbaceous species richness have been observed following cessation of herbicide treatments (DiTomaso et al. 1997). The use of herbicides effectively reduces shrub cover, which increases solar radiation to the forest floor. As a result, grasses and forbs that would normally be outcompeted by the aggressive post-fire response of shrubs are able to persist in larger proportions (McDonald and Abbott 1997); however, such increases may result from invasion by undesirable species such as cheat grass (McGinnis et al. 2010). Herbicide treatments for noxious weeds, as well as subsequent reforestation release treatments, would help to minimize spread and establishment of invasive exotic plant species.

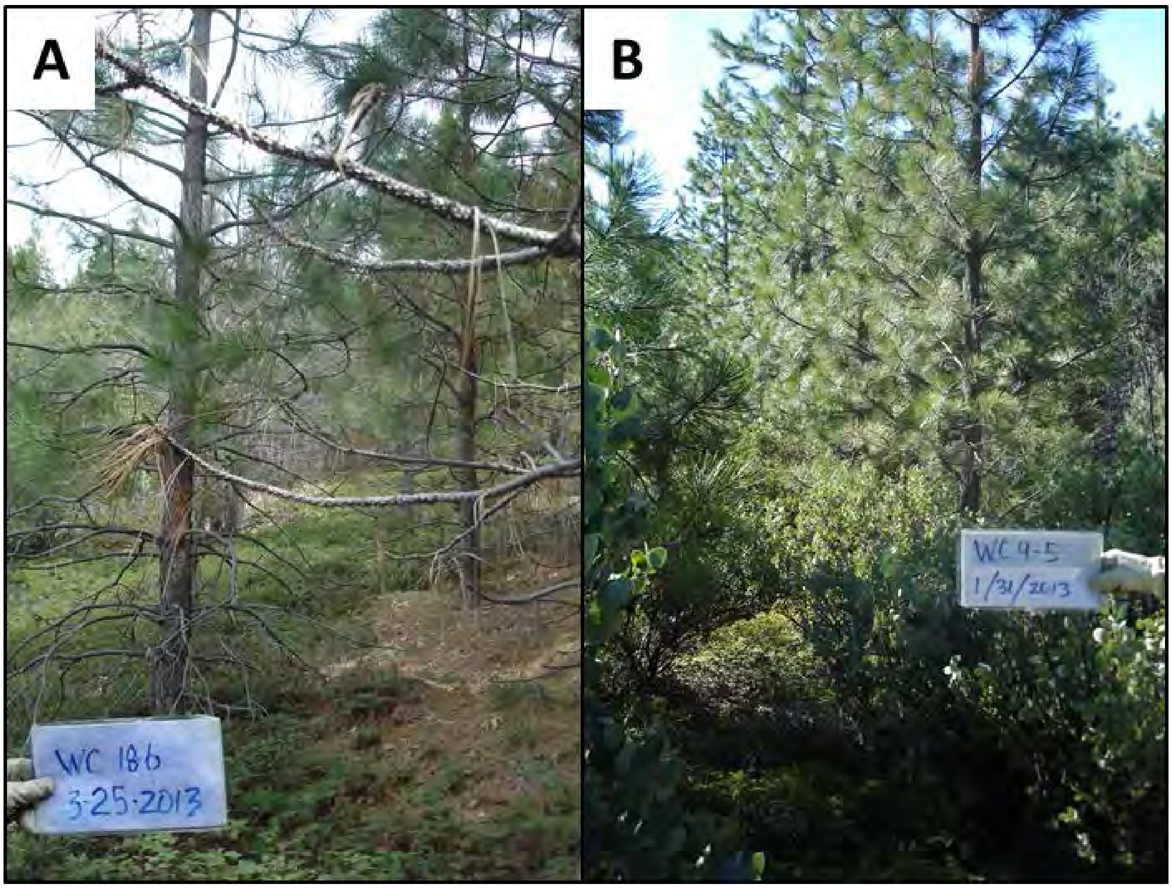

Figure 3.13-5 Understory Vegetation in 15-Year Old Walton Cabin Plantations Prior to the Rim Fire

Prescribed Fire

Introducing prescribed fire while plantations are still fairly young (about 10 years old) would also facilitate reestablishment of native shrubs species. Prescribed fire stimulates germination of *Ceanothus* species that require fire for seed scarification, promoting recovery of the herbaceous understory (Kauffman and Martin 1991). Prescribed fire, which would also slow development of large decadent shrubs after herbicide release treatments stop, would maintain small openings in shrub canopies and allow a greater abundance of grasses and forbs to persist within plantations for a longer period of time.

Tree Development and Densities

Tree crown characteristics are influenced by shrub competition and tree density. As trees grow and expand lateral branches, they must physically compete with neighboring trees and other vegetation for growing space as well as water and nutrients belowground. Higher stand densities reduce the amount of time before trees grow large enough to begin competing with each other for physical growing space. Like shrubs, higher tree densities can also reduce diameter and height growth, but depending on how closely trees are spaced this effect may not occur for 10 to 30 years. The effect of shrub competition is more pronounced in earlier years before inter-tree competition begins. Oliver (1979) evaluated the effect of different tree spacings with and without shrub removal. Trees spaced greater than 12 feet apart that were free of shrub competition did not experience reduced height or diameter growth during the 12 year study period; however, shrub competition significantly reduced diameter, height, crown width, and branch diameter. Trees spaced 6 feet apart did experience inter-tree competition for light and belowground resources. Similarly, trees grown close together such as in clumps are more likely to shed portions of their crown that are shaded by neighboring trees and vegetation than trees that are open grown. For the most part, however, tree spacing proposed under the Alternative 1 planting patterns is large enough that most trees would not experience significant declines in growth or self-pruning during the first 10 to 30 years.

Table 3.13-9 summarizes tree development and densities for Alternative 1. Growth simulations estimate that conifer diameters would average just over 4 inches at breast height at year 20 and almost 14 inches by year 60. Average conifer heights at years 20 and 60 would be about 23 feet and 75 feet, respectively similar to heights observed by McDonald and Abbott (1997) in study plots with low competing vegetation. As shown in Table 3.13-9, tree heights at year 10 in their study were slightly taller on average (10.6 feet and 8.7 feet in plots with low and moderate abundance of competing vegetation) compared to estimates made using RCONIFERS. Table 3.13-9 shows at year 18, McDonald and Abbott (1997) observed slightly shorter tree heights (14.9 to 20.9 feet) compared to 20-year estimates made using RCONIFERS. The RCONIFER estimates of dbh and height are also comparable to other plantation growth models produced for northern California (Oliver and Powers 1978).

Table 3.13-9 Alternative 1: Tree Density and Characteristics at Years 10, 20 and 60

Species	Year	PCR Mean	CBH Mean	DBH Mean	DBH Minimum	DBH Maximum	Height Mean	Height Minimum	Height Maximum	TPA Mean	TPA Minimum	TPA Maximum
Conifers	10	93	1	0.7	0.0	1.4	7.3	2.7	10.7	176	104	207
Conifers	20	70	7	4.3	0.4	6.8	23.2	6.7	34.0	175	104	207
Conifers	60	61	29	13.9	4.8	24.1	74.8	23.6	111.1	157	98	179
Hardwoods	10	78	2	1.0	0.0	3.0	9.6	4.6	22.5	50	38	63
Hardwoods	20	44	13	4.0	2.6	5.9	23.9	16.1	37.3	20	15	25
Hardwoods	60	29	27	6.1	4.0	10.6	38.3	23.0	53.8	16	10	22

PCR=percent crown ratio; CBH=canopy base height in feet; DBH=diameter at breast height in inches; TPA=trees per acre

Tree density would vary by slope position because of the different planting patterns that are summarized in Table 2.02-2. Lower tree densities would occur on fuelbreaks and primary ridges, while the highest densities would be planted in drainages where conditions are cooler, moister and better suited for denser forest. After accounting for initial mortality and oak buffers, tree densities would range from 104 to 207 trees per acre during the first 10 years. Overall, the average tree density at year 10 is estimated at 176 trees per acre. Assuming no major disturbances occur (e.g., stand replacing fire, mechanical thinning, insect outbreak), background or normal mortality rates would reduce conifer density to 157 trees per acre on average and range from about 98 to 179 trees per acre by year 60. Areas with lower tree density or larger spacing between clumps would likely develop higher shrub cover in the long-term. Lydersen and North et al. (2012) found that tree densities on ridges and mid-slopes were often associated with greater shrub cover.

Pine species would comprise a greater proportion of the plantations. Over the next 60 years, pine would comprise about 70% of the density, of which, 15 to 20% would be sugar pine. Oak and other hardwoods would initially comprise about 22% of overall tree density. Hardwood species generally never exceed heights of more than 60 to 80 feet, but conifer species commonly reach heights of 100 to 200 feet. Growth simulations predict that conifers would begin to overtop oak and other hardwoods after 15 to 20 years. As the conifers increase in size and can more effectively compete for water and light, hardwood density will decrease. Competition between hardwoods would also contribute to declining hardwood densities as more dominate individuals expand into the growing space of neighbors. By year 60, hardwoods are projected to comprise about 8-10% of the tree density, which is comparable to historic accounts of oak density at about the same elevation. On the Stanislaus, Sudworth (1900) estimated that the highest densities of California black oak occurred between 3,500 and 4,500 feet elevation, comprising 5 to 10% of most stands. The majority of the Rim Reforestation project area is less than 5,000 feet.

Various planting patterns are proposed based on slope position. The distribution of planting patterns reflects patterns observed by Lydersen and North (2012), with higher tree densities and larger tree-clumps located on lower slopes and lower tree densities and smaller tree-clumps located on upper slopes and ridges. Planting seedlings in clumps also reflects natural patterns of regeneration to an extent. For example, Sudworth (1900) described conifer regeneration as being patchy, but the patches of regeneration were growing among intact forest and not within large patches of severely burned forest. While planting patterns would promote a clumpy distribution of seedlings and saplings in the short-term, key structural components would be absent until the development of large trees, which with their presence, create conditions suitable for natural conifer regeneration. Based on an extensive review of research related to tree spatial patterns, Larson and Churchill (2012) describe the common driving mechanisms of tree spatial patterns in dry conifer forest of the western U.S. Key components include clumps of trees across a range of sizes and ages (e.g., patches of old large trees to patches of regeneration), widely spaced individual trees and openings. The process of frequent fire maintains this heterogenic structure by creating new openings, which then naturally regenerate from seed produced by nearby patches of mature trees. This vegetation-disturbance dynamic is reflected in other research in Sierran mixed-conifer forests. Lydersen and North (2012) note that areas burned at lower intensity promoted tree regeneration and areas burned at higher intensity created shrub habitat. Crotteau et al. (2013) observed greater conifer regeneration in areas with low to moderate burn severity, while areas that burned with high-severity had lower conifer regeneration and high shrub cover. Crotteau et al. (2013) attribute the lower shrub cover in areas that burned with low severity to high shade provided by residual mature trees. Lower shrub abundance and nearby seed sources then produce greater amounts of patchy conifer regeneration. The uncharacteristically large high-severity patches created by the Rim Fire left few if any remaining large trees and an abundance of shrub cover; therefore, restoration of the vegetation-disturbance dynamic described by Larson and Churchill (2012) would not occur until a diversity of tree ages and sizes have developed. Planting patterns may result in a more patchy structure of seedlings and saplings in the short-term, but would not accelerate the development of large trees compared to simpler planting patterns (e.g. Alternative 5) as shown in Table 3.13-9 and Table 3.13-13. As the trees develop over the next 50 to 60 years, it is the future disturbances (e.g., fire, mechanical thinning, insects and diseases), future natural regeneration and variation in microsite productivity that will promote development of fine-scale heterogeneity in tree age, size, densities and spatial arrangements.

Nutrients and Water Availability to Trees

The effectiveness of site preparation and release treatments (especially herbicide treatments) strongly correlates with increased water availability to trees. Competition with dense shrubs slows the initial growth of conifer seedlings (Conard and Radosevich 1982a; Lanini and Radosevich 1986; McDonald and Fiddler 2001; Oliver 1990; Stuart et al. 1993). Although shrubs have been shown to improve nitrogen fixing and soil fertility (Conard et al. 1985; Busse 2000; Busse et al. 1996), water availability has been shown to override the beneficial effects of improved nutrient availability on tree growth. Powers and Ferrell (1996) concluded that on droughty sites, vegetation control plus fertilizer did not improve tree growth beyond vegetation control alone. Powers and Ferrell (1996) also found that on more productive sites, fertilizer application without vegetation control boosted shrub growth and blocked trees from the beneficial effects of increased nutrient availability. Similarly, Powers and Reynolds (1999) found that on sites that were both droughty and infertile, trees responded to increased water availability before increased nutrient availability. Others have affirmed the benefits to tree growth resulting from early shrub control and increased water availability (McDonald and Fiddler 2010; Stephenson 1990; Zhang et al. 2006). Reforestation treatments increase water availability to conifer seedlings; thereby, setting stands on a trajectory to conifer dominance and the creation of structures (e.g., large trees) more like those that existed pre-fire. Reforestation treatments also provide opportunities to restore forest structure consistent with historic conditions (Sensenig et al. 2013).

Climate Change Influences

Concern has been raised over whether or not it is appropriate to conduct reforestation throughout the project area given changes in site suitability and potential vegetation shifts resulting from warming climate trends. All tree species have a threshold for drought, beyond which no growth occurs (Hinckley and Scott 1971; Royce and Barbour 2001; Waring and Cleary 1967). With trends of increasing temperatures and decreasing snow packs in the Sierra Nevada (Lutz et al. 2010; Safford et al. 2012; Thorne et al. 2008), understanding the drought-related thresholds of tree species can help us understand the potential extent of vegetation change that may occur because of changing climate, and assess the sensitivity of individual species within a particular location (Hannah et al. 2002). Species that are currently close to their drought threshold or water-balance range limit may be affected by increasing water deficits (Breshears et al. 2009). Lutz et al. (2010) evaluated the effect of increasing summer water deficit on individual tree species found in Yosemite National Park. The metric used by Lutz et al. (2010) for measuring water balance was the predicted ratio between actual evapotranspiration and potential evapotranspiration as affected by warming climate trends. They compared the water balance where each tree species is found within Yosemite to the North American range of each species to determine which species might be close to their drought threshold. Of all the species evaluated, western white pine and mountain hemlock were the only two species with study plots clustered around the lower North American threshold for water balance; and therefore, are the most at risk. Lutz et al. (2010) concluded that most of the same species found in the Rim Reforestation project (i.e., California black oak, Douglas-fir, incense cedar, ponderosa pine, red fir, sugar pine and white fir) may occur in locations that will put them at increasing risk of water deficit-related mortality. That is, the study plots where these species were located were clustered toward the arid end of their North American range; however, within the North American range each species was found on sites with a lower water balance than that observed in Yosemite. For example, Lutz et al. (2010) estimated the North American water balance range for ponderosa pine to be about 0.32 to 0.99, with a mean of about 0.6. The majority of the areas where ponderosa pine is located in Yosemite occurred between 0.42 and 0.63, with an average of about 0.53. While the average in Yosemite is lower than the average of the North American range, the majority of ponderosa pine sites are still well above the lower threshold. Therefore, some sites may reach their drought threshold for ponderosa pines as temperatures increase, but these would likely be areas with the lowest site productivity. Based on this information, reforestation in some areas under Alternative 1 may experience future water deficit-related mortality. As noted by Lutz et al. (2010), however, the scale used for modeling climate is still fairly coarse and underpinned by uncertainty. Topography in the project area is highly variable, and like most areas in the Sierra Nevada range, results in highly variable microclimatic conditions that drive vegetation structure and composition (Lydersen and North 2012); therefore, future climate related mortality is likely to reflect the fine-scale heterogeneity of the biophysical landscape. While conifer species may eventually die-off in isolated areas that are planted, many areas dispersed across the project area would likely remain habitable to conifers and persist despite warming temperatures. Furthermore, areas of poor site quality would likely be dropped during unit layout or skipped during site preparation and planting.

In light of potential future water deficit-related mortality caused by climate change, the concept of focusing reforestation efforts within climatic refugia, or envelopes, has been raised. Loarie et al. (2008) explain that climate trends in California will likely result in shifts in vegetation diversity and distribution. From a conservation perspective, species that are able to expand their ranges should garner the least concern; however, species with shrinking ranges will likely require the most attention and human assistance. As exemplified by Lutz et al. (2010), mountainous areas are expected to harbor species with shrinking ranges and may provide future refugia that act as a life boats for biodiversity into the next century (Loarie et al. 2008). Groves et al. (2012) argues for a broader approach to incorporating climate change into conservation planning because conserving climate refugia represents only a partial solution to climate change adaptation and relies largely on climate projections and all their associated uncertainties. Additionally, coarse-scale climate envelope models may overestimate or misrepresent the projected extinction rates for a given area because they often fail to capture topographic or microclimatic buffering (Groves et al. 2012; Willis and Bhagwat 2009). Millar et al. (2007) suggest that redundant planting across a range of environments may capture fine-scale microclimates, increase diversity and provide an ecological buffer that spreads risk rather than concentrates it. Furthermore, mixed-conifer refugia are often characterized as cool, moist sites that are relatively productive. Productive sites with infrequent fire will tend to burn at higher severities (Lutz et al. 2012). Kane et al. (2015) demonstrated that this was the case with the Rim Fire. Because fire responds rapidly to climate, effects of fire will likely overshadow the direct effects of climate on tree species distributions and migrations (Dale et al. 2001; Flannigan et al. 2000). Therefore, Alternative 1 would help spread the risk that fire poses to declining conifer species in lower elevations (especially sugar pine) across a greater proportion of the Rim Fire landscape; capturing a higher frequency of suitable microclimates that may otherwise remain dominated by shrubs and hardwoods for decades or centuries. It would also increase connectivity of conifer forest, which would enhance ecosystem integrity by increasing the ability of tree species to move and adjust to future climate conditions and disturbances (Groves et al. 2012).

Genetic Diversity

Some literature has raised concerns over genetic diversity being low in plantations due to planting commercial species and using nursery genomes (DellaSala et al. 2014). Region 5 currently does not use seed orchards, but instead depends solely on collection of wild seed grown in nurseries. Isozyme analyses comparing naturally established conifer seedlings and nursery-grown seedlings have found no difference in genetic diversity (Shimizu and Adams 1993). Genetic variation would be reintroduced from seed collections within the local seed zone. This would be especially beneficial for promoting rust-resistant sugar pine within the project area. The trend of declining sugar pine has raised significant concern over maintaining genetic diversity in this species to ensure its long-term capacity to adapt and survive future natural disturbances and large scale threats to sustainability (Burns et al. 2008; Zeglan et al. 2010). Natural regeneration of sugar pine currently makes up only 1% of all natural conifer regeneration within the 26,009 acres proposed for reforestation. In addition to sugar pine, species composition would include a mix of planted conifers (Jeffrey pine, ponderosa pine, white fir, incense cedar, Douglas-fir and giant sequoia) and natural regeneration. The proportion of species planted would be tailored to fit the site. For example, white fir and Douglas-fir would be favored on northern aspects and drainages as opposed to a heavier mix of pine on southern aspects and ridges. Overall, however, a greater proportion of pine (about 50% ponderosa pine and 20% sugar pine) would be planted to reflect historic species composition (CREP 2008; Sudworth 1900) and because pine is less sensitive to drought than other conifer species (Ferrell et al. 1994; Hurteau et al. 2007).

Existing Plantations

Prescribed fire and mechanical thinning in existing plantations would maintain low fuel levels and remove small, excess standing dead and live trees to reduce stand densities and move plantations toward the desired ICO structure. Together these treatments would achieve the desired surface and ladder fuel loading, as well as reduce live tree density. If burn conditions do not permit safe use of prescribed fire, mechanical thinning would proceed to ensure inter-tree mortality does not occur. Tree species diversity would be promoted by removing ponderosa pine and leaving sugar pine, white fir and incense cedar and thinning around oak. On average, only about 300 board feet per acre would be removed because the majority of the merchantable size trees would be retained. Although the majority of these plantations have relatively small trees (less than 15 inches dbh), prescriptions would retain a portion of the largest standing dead trees to provide wildlife structures and future large down woody material. Prescribed fire and mechanical operations would initially kill aboveground portions of shrubs, grasses and forbs; however, reduced shading of the forest floor combined with prescribed fire and soil disturbance would stimulate sprouting and seed germination of understory vegetation. Treatments would also stimulate conifer regeneration (Zhang et al. 2013) and promote fine-scale structural complexity as new cohorts of conifers establish over time.

Thinning would improve residual tree health and vigor by removing mostly small, suppressed and intermediate sized trees that would otherwise compete for water and growing space. Reducing the number of smaller trees would initially increase the average tree diameter and height of the plantations and increase the growth of the remaining trees. Over the next 20 years, tree diameter would increase across all thinned plantations, with stand averages ranging from about 9 to 26 inches dbh in the youngest and oldest plantations. Average tree heights would range from about 40 to 105 feet, respectively. After 60 years, average stand diameters would range from 16 to 31 inches and height would range from 80 to 125 feet. As shown in Table 3.13-15, the density of large trees (greater than 24 inches dbh) across all thinned plantations would average about 21 trees per acre, which is about 15% more large trees than would occur if no action is taken.

Alternative 1 would treat about 1,990 acres, with prescribed burning only, to enhance deer habitat. Prescribed burning would cause low levels of tree mortality and potentially increase vigor of residual trees. Large areas with no conifers dominated by oak, shrubs and grasses would experience short-term effects such as aboveground mortality, but would readily sprout during subsequent growing seasons. Burning would break up the horizontal continuity of shrubs, providing more light, soil moisture and growing space for grasses and forbs. Reductions in shrub and oak cover would occur in the short-term. Over the next decade, however, sprouting shrubs and oaks, as well as new germinates stimulated during burning, would expand their crowns and reoccupy growing space.

Stand Density Index

Reforestation

Reforestation accelerates the establishment of conifer forest. Once trees have reached a size where shrub competition no longer significantly influences diameter and height growth, competition among trees for water, light and physical growing space becomes an important factor in forest development. Reforestation treatments decrease the time until inter-tree competition becomes a factor. SDI is used to evaluate the effect of inter-tree competition on forest health and vigor. Alternative 1 proposes higher planting densities based on topographic slope positions. The slope positions proposed for the highest tree densities are in drainages and on mid-slopes in areas with an old forest mosaic desired condition. These areas of higher planting densities (303 trees per acre) would require less time until the onset of inter-tree competition. Drainages and old forest mosaic mid-slopes would just reach a SDI of about 200 by year 40. By year 50 drainages and old forest mosaic mid-slopes would have a

SDI of 275 and 267, respectively. Other mid-slope positions (open canopy mosaic outside SFMAs and old forest mosaic inside SFMAs) would also exceed a SDI of 230 by year 50 (SDI 244). In total, about 17,960 acres would exceed a SDI of 230 within 50 years. Therefore, it would take about 40 to 50 years before 70% of the project area would start to show increased bark beetle-related mortality (Oliver 1995; Oliver and Uzoh 1997). After 60 years, the remaining mid-slope positions (5,471 acres) exceed a SDI of 230; however, some slope positions that are planted with lower tree densities (fuelbreaks, primary ridges and emergency travel routes) would not reach a SDI of 230 within 60 years. Even in the absence of thinning or other major disturbances, none of the slope positions reach the bark beetle induced maximum SDI of 365 within the 60-year analysis timeframe.

Although primary ridges do not reach a SDI of 230 within the next 60 years, ridges typically have shallow soils, lower soil moisture availability, and are more exposed to solar radiation. As temperatures and summer water deficits increase with changing climate, these areas are the most vulnerable to drought-induced mortality. Having lower SDI levels would improve tree resilience during periods of extended drought. Lower SDI levels, however, suggest lower tree canopy cover and increased shrub cover would occur, which would increase the risk of high-severity fire in these areas during extreme drought (Harris and Taylor 2015; Lydersen et al. 2014).

Existing Plantations

After prescribed burning and thinning, a total of 2,868 acres of plantation (about 20% of thinned plantation acres) would still exceed a SDI of 230. A portion of these acres (105 acres) are small patches of late seral closed canopy forest that would exceed a SDI 365 and eventually reach a SDI of 528 during the 60 year analysis time frame. These patches of older remnant forest are relatively small, distributed throughout the existing plantations, and would experience minimal effects from treatments. The remaining acres that exceed a SDI of 230 are primarily the older Granite plantations that also have relatively larger trees, but cannot be thinned to a lower SDI because the Forest Plan Direction requires that thinning not reduce canopy cover by more than 30% (USDA 2010a, p. 36). Thinning is estimated to reduce canopy cover between 20 and 30% in the majority of these older plantations. While SDI would still exceed 230, it would be reduced below the insect-induced maximum SDI of 365. These plantations would remain below a SDI of 365 for about 20 years and reach a SDI of 419 during the 60 year analysis time frame. By year 20, an additional 916 acres (7% of thinned plantation acres) would increase in SDI and exceed the threshold of 230. In the absence of major disturbances, an additional 4,213 acres would not reach a SDI of 230 until sometime between year 20 and 60 years after thinning. The remaining plantations would remain in a relatively open canopy structure with low conifer densities over the next 60 years. By year 60, a range of stand densities, ages and structures would exist. Some openings created during prescribed fire would likely remain open and dominated by shrubs and hardwoods. Other openings would begin to regenerate with young conifers, promoting uneven-aged structures. Aside from the 105 acres of late seral closed canopy forest, an additional 1,894 acres would exceed a SDI of 365, but no other thinned plantations would exceed the SDI threshold of 365 during the analysis period of 60 years.

During the first 10 to 20 years after thinning, residual trees would benefit from reduced stand densities, which would increase water and nutrient availability. Residual trees would increase in growth and vigor, which would accelerate development of larger trees during the analysis time frame. Reduced competition would ease water stress during dry summers and reduce tree mortality during periods of more severe drought (D'Amato et al. 2013). Although a large portion of these thinned plantations (about 6,000 acres) would not exceed a stand-level SDI of 230 during the analysis time frame, as the residual trees increase in size and occupy more growing space over the next 20 years, SDI levels would increase. Subsequently, inter-tree competition would slowly intensify and some stands would begin to show more evidence of insect-related mortality as they approach SDI levels of 230 (Oliver 1995; Oliver and Uzoh 1997). Mortality would be more severe during periods of drought when trees are water-stressed. If insects and drought are not a factor, SDI levels would continue to approach 260 to 280 (50 to 60% of maximum SDI) in some plantations. At these densities competition-related mortality would increase and result in "self-thinning" (Long and Shaw 2012). Mortality would typically occur in denser patches and on poorer sites where competition is more intense between trees, which will further promote structural heterogeneity and uneven-aged structures. As trees succumb to insect and competition, SDI levels would decrease and surviving trees would benefit from reduced live tree densities.

Future conifer regeneration was not included in these projections; therefore, SDI values are based on existing tree densities. Thinning and prescribed fire would likely stimulate some level of conifer regeneration that would eventually contribute to higher SDI levels. Future management decisions would need to assess the need for long-term management (e.g., mastication or additional prescribed fire) to address changing circumstances that are outside the scope of this analysis and project decision space.

Future Management Feasibility

Reforestation

Conifer forest that is stocked with high densities of small trees can result in high SDI levels. Conversely, high SDI levels can result from low densities of large trees because large trees require more growing space and resources for maintaining health and vigor. For this reason, conifer forests inevitably experience SDI increases, especially in the absence of significant disturbances. For this reason, thinning intermediate sized trees has been noted as sometimes being necessary to reduce competition, accelerate large tree development, and create desired fine-scale heterogeneity in Sierran mixed-conifer forests (North et al. 2009). Assuming prescribed burning or other disturbances over the next several decades do not significantly reduce tree density, plantations would eventually reach SDI levels that induce competition-related mortality. Ideally then, a scenario that balances the culmination of increasing SDI levels with the development of merchantable sized trees would provide future generations opportunities for offsetting management costs. Such a situation would avoid development of plantations with submerchantable trees that require thinning before undesirable SDI thresholds are exceeded.

Stand densities under Alternative 1 would begin to reach suitable SDI levels for requiring thinning at about the same time that merchantable sized trees have developed. Long and Shaw (2012) recommend thinning when SDI reaches 50 to 60% of maximum SDI. Assuming maximum SDI for ponderosa pine dominated mixed-conifer stands is 524, thinning should occur around the time they reach a SDI of 260. At this SDI, stands would show an increase in bark beetle-related mortality and also begin self-thinning; therefore, thinning would capture some of the potential timber volume while still maintaining desirable tree densities and sizes, as well as creating canopy openings that provide suitable conditions for pine regeneration. Drainages and old forest mosaic mid-slope plantations would be the first to reach a SDI of 260. This would occur by year 50 on 10,786 acres. At that time, thinning from below to an SDI of 170 (about 30% of maximum SDI) would remove 4,998 board feet per acre and leave 125 to 130 conifers per acre. By year 60, an additional 12,644 acres of mid-slope plantations would meet thinning criteria; however, given the lower tree densities in these plantations, trees must grow larger to achieve a SDI of 260. Therefore, thinning to the same SDI target requires removing larger trees with more volume (8,664 board feet per acre) and thinning to a lower residual conifer density (89 to 93 conifers per acre). As noted previously, some plantations (2,578 acres of fuelbreaks and primary ridges) under Alternative 1 would not reach a SDI of 230 within the next 60 years; and therefore, would not meet thinning criteria. Maintaining these strategically placed fire management areas would not produce cost offsets from removal of merchantable timber because existing tree densities would be too low. Future maintenance of ladder fuels and shrub cover in these areas could be completed at cost using prescribed fire and mechanical operations.

Existing Plantations

Prescribed fire and thinning the existing plantations today would improve opportunities for future management. Reductions in tree density would increase growth and vigor of residual trees and result in 15% more large trees per acre greater than 24 inches dbh compared to no treatment as shown in Table 3.13-15. In general, a greater number of commercial size trees would exist in the future compared to Alternative 2. As stands continue to increase in density and accumulate ladder and surface fuels, removing some of the merchantable intermediate sized conifers would help offset costs associated with future fuels reduction operations and wildlife habitat improvement projects.

Change in Forest Structure

Reforestation

Reforestation treatments would accelerate the establishment of conifer forest in uncharacteristically large patches of high-severity fire within a matter of years as opposed to decades or potentially longer. Once conifers are established, mid and late seral successional structures would begin to develop. Alternative 1 would reforest 16,184 acres more than are currently regenerating naturally. In areas that are regenerating naturally (9,825 acres), treatments would help favor a desirable mix and density of conifer species. Of the 26,009 acres proposed for reforestation, 3,096 acres are currently considered complex early seral forest created by high-severity forest fire (not including areas of moderate burn severity) because they were severely burned and have not been altered by humans (DellaSala et al. 2014; Odion and Hanson 2014). Reforestation activities would reduce the "complexity" of these areas by removing standing dead trees and controlling understory vegetation, but would also accelerate the development of conifer forest. The other areas proposed for reforestation are primarily severely-burned forest that have been impacted by salvage logging or hazard tree removal under the Rim Recovery and Rim HT projects and would otherwise remain dominated by dense shrub thickets with scattered patches of dense white fir and Douglas-fir.

Over the next 30 years, all plantations would progress from early seral successional classes into mid seral successional classes as the average tree size increases. On average, canopy cover would range between 10% and 39%, which is still an open canopy condition. By year 40, most of the plantations (90%) would reach canopy covers of greater than 40%. Given the variation of planting densities and topographic positions, less than 3,000 acres would remain in a mid-seral open canopy condition with 25 to 39% canopy cover after 40 years. These open canopies would occur on the fuelbreaks, primary ridges and emergency travel routes. In the absence of major disturbance, all plantations would reach a mid-seral closed canopy condition by year 50 with canopy covers of 40 to 69%.

In the long-term, future management and disturbances would transition plantations into various successional classes. As exemplified by the Rim Fire, a portion (22%) of the existing plantations experienced high severity fire and were reset to an early successional stage; however, the majority of the plantations within the Rim Fire experienced a range of burn severities. About 22% experienced moderate burn severity, shifting them from a mid-seral closed canopy condition to an open canopy condition. About 56% experienced low burn severity. Although the canopy condition of these plantations did not significantly change, low levels of mortality would increase the health and vigor of residual trees, accelerating development of late seral conditions. Had these plantations not existed prior to the Rim Fire, they would likely have been dominated by shrub and hardwood vegetation as a result of slow conifer succession following past fires; however, they are now contributing to structural diversity across the landscape.

Existing Plantations

Prescribed burning and thinning treatments in existing plantations would increase the diversity of forest structure across the landscape. The transition between different structural classes is not static; rather, it is a dynamic process driven by tree competition, development and disturbance. Thinning and prescribed fire would accelerate transition between structural classes. Some structural classes such as open canopy conditions would not occur in the absence of thinning, prescribed fire or some other disturbance. Treatments proposed in the younger Rogge plantations would reduce tree competition and accelerate the transition from an early seral structure (average dbh 1 to 6 inches) to a mid-seral structure (average dbh 6 to 11 inches). Similarly, thinning older plantations that are currently in a mid-seral closed canopy structure would transition them into an open canopy structure and accelerate the transition of some plantations into a late seral structure. After 20 years, a portion of the mid seral open canopy conditions would transition into a late seral open canopy condition, which is currently the rarest structural class on the Rim Fire landscape (Figure 3.13-2). Over the course of the next 60 years as trees continue to increase in size, all the plantations would eventually return to a closed canopy condition (greater than 40% canopy cover), but this would not occur until sometime between years 50 and 60. During the next 50 to 60 years, Alternative 1 would provide a greater range of both open and closed canopy conditions compared to Alternative 2.

A total of 2,187 acres of high-severity patches are distributed throughout existing plantations. Although relatively small, these patches would fit the definition of complex early seral forest (DellaSala et al. 2014; Odion and Hanson 2014). About 1,532 of these acres experienced high-severity fire, which occurred in small patches scattered throughout the 13,934 acres proposed for thinning. The remaining 655 acres resulted from moderate-severity fire and are also relatively small patches scattered throughout existing plantations. Trees in these patches are relatively small (less than 15 inches dbh), so thinning would remove some of the dead trees to reduce fuel loading; however, a portion of the largest dead trees would be retained.

To enhance deer habitat, an additional 1,990 acres are proposed for prescribed burning only. Areas that do not currently have trees would not contribute to changes in landscape forest structure. Prescribed fire may decrease tree canopy cover a small amount depending on fire-caused mortality. This effect would be minimal on a landscape scale and last for relatively short time (less than 20 years).

CUMULATIVE EFFECTS

The temporal boundary of this cumulative effects analysis is limited to the time frame in which future management activities are completed. Past management activities have shaped the existing condition and are not considered further. Activities that occur outside of the project area may affect vegetation, but would have no influence on vegetation growth, composition or structure within the project area. Therefore, all ongoing, present, and foreseeable activities that occur outside of the Rim Reforestation project area do not additively contribute to the direct and indirect effects discussed under Alternative 1 for the following indicators: tree size and composition, stand density index and future management feasibility.

The following list describes ongoing and present and reasonably foreseeable future actions within the project area that do not cumulatively affect vegetation.

- Ongoing livestock grazing may affect vegetation locally where cattle gather. Cattle do not typically eat shrubs or trees. Cattle can trample or crush young seedlings; however, management requirements are in place to reduce conflicts between range and reforestation activities. Range activities would have no detectable effect on shrubs or conifer growth and therefore no potential for cumulative effects.
- Present and future transportation-related treatments (maintenance, construction, rerouting, culvert replacement/repair, gate installations and designation changes to roads or trails) do not affect sufficient amounts of vegetation to create a detectable change from existing conditions.
- Ongoing, present and future recreation-related activities are primarily concentrated in areas that would not pose conflicts with reforestation and thinning activities. Any potential changes to vegetation caused by recreation would not be detectible at a significant scale and would not contribute to cumulative effects. Travel by recreationists on designated travel routes does not

change vegetation; therefore, authorized motorized travel has no potential for a cumulative effect on vegetation.

- Present and future Rim Habitat and Rim Rehabilitation projects, including fence repair, great gray owl habitat improvement, installation of water troughs and guzzlers, botany restoration areas, weed treatments and meadow work could potentially impact a small number of shrubs and trees; however, the effect would not be detectible.

Present activities within the project area that do contribute to cumulative effects include the Rim Recovery and Rim HT projects which include various mechanical operations that would reduce natural conifer regeneration and understory vegetation. These effects are accounted for in the affected environment and direct and indirect effects under Alternative 1.

Change in Forest Structure

The present and foreseeable actions discussed here primarily occur outside of the Rim Reforestation project area (private lands, Yosemite National Park and other lands within the Rim Fire perimeter), but may contribute to changes in landscape forest structure. Present and future management activities not included here would not cumulatively contribute to detectible changes in landscape forest structure.

Present Actions

- The Rim Habitat project would remove encroaching conifers to improve meadow habitat. This project would reduce tree cover on 397 acres. This amounts to less than 1% of the entire Rim Reforestation project area and less than 0.2% of the Rim Fire landscape.
- The Groovy Stewardship project would primarily affect 1,319 acres of mid to late seral closed canopy forest. Treatments would decrease tree density and move stands into an open canopy forest structure.

Foreseeable Future Actions

- Reynolds Creek Ecological Restoration Aspen Release would reduce conifer density in aspen stands. Tree cover would remain and have minimal effects on landscape forest structure.
- Reynolds Creek Ecological Restoration Meadow Restoration would remove conifer tree cover from meadows on no more than 15 acres.
- The Reynolds Creek Fuels project would prescribe burn 2,288 acres in recently thinned stands. Prescribed fire would reduce shrub cover, conifer regeneration and small tree density, but likely have little effect on large tree density. By reducing conifer regeneration and small tree density, it would maintain 2,288 acres in an open canopy condition.
- Rim Rehabilitation project work including aspen release would reduce conifer density on 32 acres. Although the aspen release work would reduce conifer cover on a very small area, tree cover would remain.
- The Reynolds Creek and Funky Stewardship projects and the Soldier Creek, Campy, Looney and Thommy Timber Sales would affect 3,953 acres of mid to late seral closed canopy forest within the Rim Fire perimeter. Treatments would decrease tree density and move stands into an open canopy forest structure.

Most of the present and future management activities (e.g., aspen release) affect a small area and would not significantly contribute to cumulative changes in landscape forest structure. Projects that affect a larger area, such as green thinning and prescribed fire would contribute a more significant cumulative change to landscape forest structure. Currently, there is a deficit of mid and late seral open canopy structure (Figure 3.13-2). Green thinning projects would move 5,272 acres of closed canopy forest into an open canopy condition, which would increase the proportion of open canopy structure from about 17% to 20% within the entire Rim Fire landscape. These projects would move the landscape closer to a more natural range of variability by increasing forest structures that the landscape is lacking. Similarly, prescribed fire and treatments that reduce small tree density (e.g., prescribed fire in recently thinned stands) would maintain acres already in an open canopy structure for a longer period of time.

On private land, 15,479 acres have already been salvage logged, site prepped and planted. Present and future actions include herbicide release treatments to accelerate growth of conifers. Release treatments would reduce the cover of understory vegetation over the next few years. Because these acres have been salvage logged, they are not counted as complex early seral forest. These plantations would not impact the remaining 34,499 acres of complex early seral created by high-severity fire in the Rim Fire, but would accelerate the transition from early seral structure to mid and late seral structures. This would reduce the proportion of early seral structure within the Rim Fire landscape by about 8%. Within the next 20 to 40 years, plantations on private land would develop into mid seral forest. Transition into open or closed canopy conditions would be subject to land owner decisions and is outside the scope of this analysis.

In total, Alternative 1 would contribute to the following cumulative changes to landscape forest structure:

- On NFS lands, early-seral conifer forest would be reduced from 44,975 acres to 18,966 acres. The remaining early-seral forest makes up about 19% of the conifer forest on NFS lands (102,618 acres) within the Rim Fire perimeter, which is within the 15 to 20% historic range for early-seral structure (Safford 2013). The majority (66%) of these early-seral acres are comprised of complex early seral forest resulting from high-severity fire (not including areas of moderate burn severity). This project would reduce the 17,163 acres of high-severity complex early seral forest on NFS lands to 12,535 acres.
- On all lands within the Rim Fire perimeter, post-fire early-seral conifer forest would be reduced from 71,552 acres to 30,064 acres. This includes 15,479 acres of reforestation on private lands and the 26,009 acres of reforestation on NFS lands. The remaining early-seral forest makes up about 17% of the Rim Fire landscape (including private land, Yosemite National Park and other public lands summing to 182,327 acres of conifer forest), which is within the 15 to 20% historic range for early-seral structure (Safford 2013).
- On all lands within the Rim Fire perimeter, complex early seral forest created by high-severity fire (not including areas of moderate burn severity) would be reduced from 34,499 acres to 29,871 acres. These remaining 29,871 acres of severely burned conifer forest will not have been impacted by salvage, hazard tree or reforestation activities and are not expected to be impacted in the foreseeable future. These acres make up about 16% of the Rim Fire landscape (including private land, Yosemite National Park and other public lands summing to 182,327 acres of conifer forest), which is within the 15 to 20% historic range for early-seral structure (Safford 2013).
- Future mid seral closed canopy conditions would increase on up to 38,971 acres. This includes plantations on both private and NFS lands. Eventually these plantations would make up about 21% of the future Rim Fire landscape, which is 6% greater than the historic estimate of 5 to 15% (Safford 2013). This is assuming no thinning or stand replacing disturbance occurs within the next 60 years. Future thinning could transition these plantations into open canopy structures and accelerate the development of late seral open canopy forest. Historically, 1.5 to 2 times the amount of mid seral open forest existed than is found today. Late seral open canopy currently has the greatest deficit; historically, about 6 to 11 times more occurred across this landscape. Combined, the new plantations on private and NFS lands could someday make up just under half of the 45 to 75% of the Rim Fire landscape that should be in a mid to late seral open canopy condition (Figure 3.13-2).
- Mid and late seral open canopy structure would increase up to 19,206 acres resulting from thinning existing plantations and other green thinning. The cumulative effect of these treatments will vary considerably over the next 60 years because forests are dynamic and transition into

various states of open canopy and seral structures depend on future climate conditions and disturbances. In general, however, thinning accelerates development of open canopy conditions, which are lacking across the Rim Fire landscape. Thinning could increase the open canopy structure across the Rim Fire landscape by up to about 11%.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

Tree Size and Species Composition

Reforestation

High- and moderate-severity patches are not reforested under Alternative 2. Immediately after the Rim Fire, vegetation (including shrubs, grasses, forbs and noxious weeds) rapidly responded and began increasing in abundance in moderate- and high-severity burn areas. During the first few years after a wildfire, turnover in species composition is considerable, as species that favor young burns give way to other species that favor older burns (Siegel et al. 2011). Although grasses, forbs and noxious weeds increase in abundance after wildfires, in a matter of years shrubs will overtop them and increase in dominance. For example, equations developed by Kie (1985) indicate that deerbrush and whitethorn shrub growth will increase 35 to 50% following reductions in canopy cover of 35 to 65%; similar to those found in moderate- and high-severity burn patches. During these first years after a wildfire, conifer regeneration also occurs; however, episodic events and conditions such as seed dispersal, bare soil, soil moisture and low shrub competition must coincide to result in continued conifer establishment and survival (Bonnet et al. 2005). As a result, conifer regeneration immediately after the Rim Fire was patchy, limited in extent (9,825 acres out of 26,009 acres), and mostly occurred within close proximity to mature conifers that survived the fire as displayed in Table 3.13-8 and Figure 3.13-4.

Additional reforestation would rely on secondary succession to reforest following the Rim Fire. Secondary succession is a plant-by-plant replacement process that occurs following a disturbance, where one plant species invades and replaces another (Horn 1974). Reinvasion of severely-disturbed forests often is very slow and unpredictable because of complex interactions among propagules as well as site and climatic conditions (Kozlowski 2002). While conifer seed dispersal is possible for longer distances (Shatford et al. 2007), the proportion of seed produced and dispersed is typically low at 1 to 5% (Nathan et al. 2002). Furthermore, seeds dispersed longer distances are less likely to successfully germinate and persist (Lesser and Jackson 2013; Nathan et al. 2002; Saigo 1969), which slows succession from shrub dominance to conifer forest. High and moderate severity areas would likely continue being dominated by shrubs similar to untreated control stands examined in research (McDonald and Fiddler 1995). In mixed-conifer forest types, Crotteau et al. (2013) found that shrubs continued to dominate high-severity patches 10 years after a wildfire, overtopping more than 60% of natural conifer regeneration in high-severity patches. McDonald and Fiddler (1995) found that forest areas in the Sierra Nevada that were dominated by shrubs required treatment to return conifer dominance. McDonald and Abbott (1997) found that areas not treated to reduce ceanothus and manzanita experienced changes in dominance of shrub species through time, but shrubs continued to dominate and increase in dominance over the next 31 years.

Slow secondary succession from shrubs to conifer forest has been observed within the Rim Fire perimeter. Figure 3.13-6 displays aerial photographs of the Crane Meadow vicinity, which burned in the 1973 Granite Fire. The photographs were taken in 1944 (prior to the fire) and 1998 (25 years after the fire). Following the Granite Fire, the Forest Service artificially regenerated the areas surrounding the private parcel, outlined in the center of the photographs. As shown on the 1998 photo, the regenerated areas grew; however, the private land was never planted and exemplifies the lack of natural regeneration and the potential long-term impacts of high-severity fire in Sierran mixed-conifer forests.

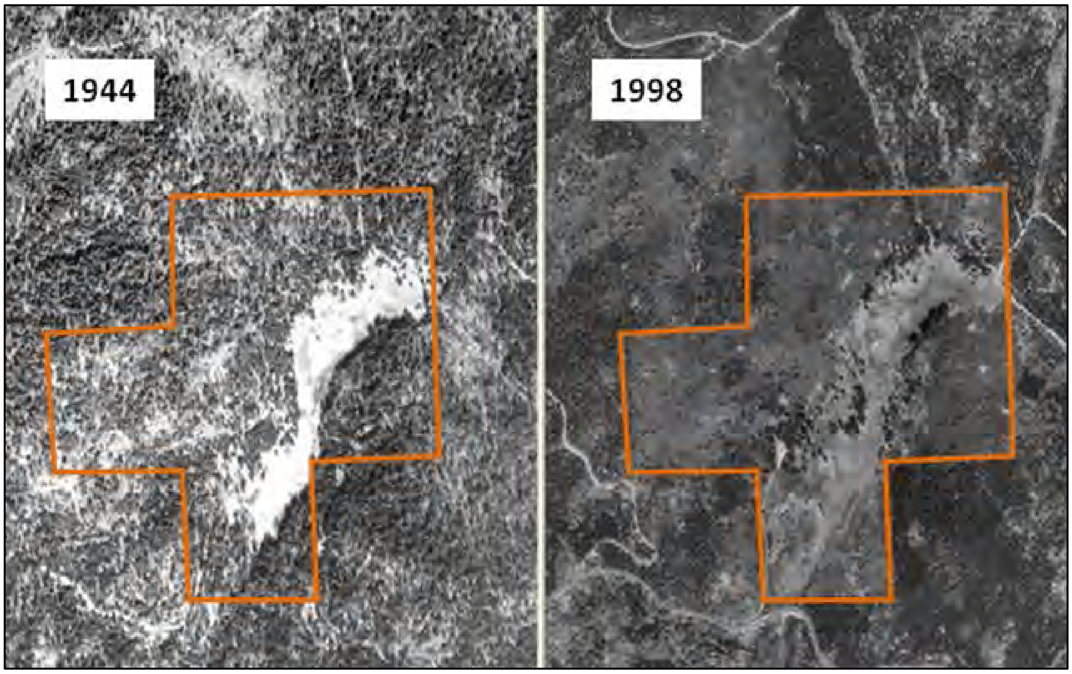

Figure 3.13-6 Forest Regeneration Comparison near Crane Meadow Following 1973 Granite Fire

Competition with dense shrubs has been shown to slow the initial growth of tree seedlings (Conard and Radosevich 1982a; Lanini and Radosevich 1986; McDonald and Fiddler 2001; Oliver 1990; Stuart et al. 1993). Therefore, natural conifer regeneration would likely experience the slowest growth of all the alternatives. Table 3.13-10 summarizes conifer and hardwood growth at years 10, 20 and 60. It also shows estimated tree densities throughout the 60-year analysis time frame. Compared to the other alternatives, the effects of no release treatments become evident by year 10. The average height of conifers is only 3.6 feet compared to 7.3 feet under Alternative 1. By year 20, average height under Alternative 2 is about half as much as Alternative 1. Competition also significantly slows tree diameter growth. The average conifer dbh under Alternative 2 at years 10 and 20 are about 3.5 times less than Alternative 1. The size of hardwoods would not be that different from Alternative 1. Height growth projected by RCONIFERS was similar to findings of McDonald and Abbott (1997) in study plots with medium to high levels of shrub cover. Slower conifer growth would also prolong the time before conifers begin to overtop hardwoods. As a result, hardwoods would experience slightly lower levels of competition related mortality in the first 10 to 20 years; however, this effect would be small because inter-tree competition would still occur between hardwoods, which would also decrease hardwood densities over time.

Table 3.13-10 Alternative 2: Tree Density and Characteristics at Years 10, 20 and 60

Species	Year	PCR Mean	CBH Mean	DBH Mean	DBH Minimum	DBH Maximum	Height Mean	Height Minimum	Height Maximum	TPA[1] Mean	TPA[1] Minimum	TPA[1] Maximum
Conifers	10	87.8	0.4	0.2	0.0	0.8	3.6	1.4	7.9	571	279	6,506
Conifers	20	61.0	4.8	1.7	0.0	5.1	12.4	3.4	27.6	482	254	2,373
Conifers	60	48.0	29.5	9.0	3.3	25.5	56.7	17.6	110.2	344	236	814
Hardwoods	10	83.3	2.0	1.8	0.5	3.7	12.1	6.9	23.7	53	38	104
Hardwoods	20	58.6	10.5	4.2	2.1	6.0	25.5	17.7	32.0	20	14	37
Hardwoods	60	39.7	26.0	6.8	3.5	11.4	43.2	27.3	53.6	15	5	24

PCR=percent crown ratio; CBH=canopy base height in feet; DBH=diameter at breast height in inches; TPA=trees per acre
[1] Trees per acre is based on acres with natural conifer regeneration and does not include acres without conifer regeneration

By year 60, the difference between conifer tree size under Alternative 2 and the other alternatives tends to decrease. For example, dbh at year 60 under Alternative 2 is about 1.5 times smaller than Alternative 1, compared to about 3.5 times smaller than at year 20. This trend is likely caused by two factors: effects of tree competition and abrupt changes in competition derived from the modeling methodology. Although only a portion of the project area has conifer regeneration (9,825 acres out of 26,009 acres), where it does occur, it is patchy and typically very dense. On average there are over 500 seedlings per acre, but in many cases conifer seedling density exceeds 1,000 per acre. Table 3.13-10 displays high tree densities would cause intense competition between young trees and over time cause tree densities to sharply decline, but still remain relatively high. As tree densities decline, residual trees would experience increases in growth rate and the difference in dbh and heights compared to the other alternatives would slowly shrink with time. Beginning at year 20, FVS was used to model growth instead of RCONIFERS. Unlike RCONIFERS, FVS assumes trees are well-established and relatively free from competition-related growth effects from understory vegetation. Therefore, transferring to FVS would effectively emulate a release treatment at year 20. While all alternatives would experience some level of the same release, this effect is likely more exaggerated under Alternative 2 than any other alternative because the trees are smaller and the average tree height (about 12 feet) is small enough to suggest that trees are still competing with shrubs. For instance, Shatford et al. (2007) noted that during the first 10 to 20 years the majority of conifers they observed were overtopped by competing vegetation because shrub growth remains relatively vigorous during this time period. Although shrubs tend to slow in growth after year 20, they are fully developed and still sequestering a substantial amount of water and light resources to maintain respiration of living tissues. Despite this plateau in shrub growth rates, conifers must still compete for water and light, which results in sustained slow tree growth that is not accounted for in FVS.

Research in Sierran mixed-conifer forests suggests that, in addition to large patches of moderate- and high-severity fire being dominated by a mix of shrub species, tree species dominance typically shifts from ponderosa pine, sugar pine and Jeffrey pine to fir species (Collins and Roller 2013; Crotteau et al. 2013; Nagel and Taylor 2005). Some instances of relatively high densities of ponderosa pine regenerating after wildfires have been documented. After the Freds Fire on the El Dorado National Forest, Bohlman (2012) observed high levels of natural ponderosa pine regeneration; however, they note that the relatively high abundance of ponderosa pine was somewhat unique in their experience compared to regeneration inventories they had conducted on 15 other fires. Table 3.13-8, showing plot data in the Rim Reforestation project area, confirms that a trend of shrub and fir dominance is likely to occur. This table also shows the proportion of all pine species combined (ponderosa pine, sugar pine, knobcone pine, grey pine and Jeffrey pine), currently accounts for 13% of all conifer regeneration within the project area and is not expected to naturally shift to pine dominance within the next 60 years. Areas of very high seedling densities tend to be dominated by white fir or Douglas-fir. During the first 10 years, these conifer thickets would experience intense competition and self-thin increasing the proportion of pine species from about 13% to 21% by year 10. This proportional shift to pine would significantly slow as trees increase in size and inter-tree competition begins. White fir and Douglas-fir can tolerate growing in denser stand conditions than pine, so the rate of pine mortality would likely increase as the rate of white fir and Douglas-fir mortality decreases. However, given the disproportionate densities of white fir and Douglas-fir compared to pine species, a greater number of white fir and Douglas-fir trees would still likely die despite the increasing rate of pine mortality. Therefore, the proportion of pine species would continue to increase between years 10 and 60, but only an additional 5%. By year 60, pine species would make up 26% of the species composition on average. This is much lower than historically occurred in most stands, with ponderosa pine alone accounting for greater than 50% of most stands in the lower to middle elevations on the Stanislaus (CREP 2008; Sudworth 1900).

Slower tree growth during the first 10 to 20 years would also prolong the time until dependable and abundant conifer seed production occurs. Conifers can produce seed as young as 7 to 10 years old;

however, their performance is more erratic than mature trees (Laacke 1990; Oliver and Ryker 1990). White fir does not produce dependable cone crops until about age 40 (Laacke 1990), about 20 years before ponderosa pine (Oliver and Ryker 1990). The best seed producers for white fir are trees between 12 and 30 inches dbh, which is smaller than the best producers for ponderosa pine (Laacke 1990; Oliver and Ryker 1990). In California, the best seed producing size for ponderosa pine is greater than 25 inches dbh (Oliver and Ryker 1990). Based on tree age and growth model projections, white fir would likely reach necessary tree sizes for dependable seed production before ponderosa pine. Given the higher proportions of white fir and its ability to more dependably reproduce sooner than ponderosa pine, white fir would likely remain the dominant trees species.

Research suggests that low- and high-severity fire begets more of the same severity (van Wagtendonk et al. 2012). Shrub cover is a good predictor of fire behavior (Lydersen and North 2012; van Wagtendonk et al. 2012). Under low live fuel moisture conditions, shrub patches can burn at higher intensity than fuels in surrounding forest vegetation (Knapp et al. 2012; Skinner and Taylor 2006). High shrub cover and a shift toward fir dominance is likely to promote high-severity fire, especially when combined with current climate trends that are resulting in more frequent wildfire and extreme drought conditions (Coppoletta et al. 2015; Crotteau et al. 2013). The likelihood of future high-severity fire would further reduce conifer forest cover and result in expansion of shrub and chaparral vegetation. The Rim Fire is an indication that a shift in vegetation-disturbance dynamics is transpiring (Harris and Taylor 2015). This shift has precipitated as a result of forest densification (driven by fire suppression and other land management practices) and appears to be accelerated by drought conditions that are resulting from changing climate (Crotteau et al. 2013; Miller et al. 2012). If patterns of high-severity fire become entrenched, large portions of forests may become locked into cycles of repeat high-severity fires (Kane et al. 2015). Large fire-created openings in the project area are likely to remain filled with dense thickets of shrubs and scattered thickets of conifer regeneration. If a cycle of high-severity fire continues, these shrub-dominated patches would persist and expand.

Alternative 2 would provide no intervention in current departure of climate- and vegetation-disturbance dynamics compared to historic dynamics. Effects of fire will likely overshadow the direct effects of climate on tree species distributions and migrations because fire responds rapidly to climate (Dale et al. 2001; Flannigan et al. 2000). The Rim Fire has exemplified how fire might accelerate vegetation shifts by killing all or most conifer trees within uncharacteristically large high-severity patches (Harris and Taylor 2015; Miller et al. 2009). Although patches of conifer regeneration exist, they are dominated by white fir and Douglas-fir as opposed to pine. Pine is less sensitive to drought than other conifer species (Ferrell et al. 1994; Hurteau et al. 2007); therefore, these conifer patches are more likely to be negatively affected by warmer and longer periods of summer drought. Lydersen et al. (2014) and Harris and Taylor (2015) found that cool, moist areas experienced lower fire severities during the Rim Fire. These areas may act as climate refugia that provide forest cover in light of changing climate; however, Kane et al. (2015) demonstrated that during periods of extreme drought, more productive sites that have higher densities of trees and surface fuels will likely contribute to the creation of large high-severity patches. In light of climate change, areas within the Rim Reforestation project area that are regenerating with high densities of white fir and Douglas-fir may be less affected by wildfire during years of normal precipitation, but prone to high-severity fire during extreme droughts. Therefore, the small proportion of the project area that does have natural conifer regeneration is at a greater risk of being lost if severe droughts increase in frequency. The risk of losing declining pine species in lower elevations (especially sugar pine) is greater in Alternative 2, due to the likelihood of high-severity wildfire removing the remaining conifer diversity. Microclimates that are well suited for conifers and are distributed throughout the severely burned project area, would not reforest naturally or be planted within the project time frame. Conifer forest connectivity would not be enhanced or accelerated, which would reduce the ability of pine (especially sugar pine) to move and adjust to future climate conditions and disturbances.

Existing Plantations

Without thinning, smaller suppressed and intermediate sized trees would continue to compete for water and growing space, slowing the growth of individual trees. Over the next 20 years, average tree diameters would range from about 6 to almost 12 inches dbh in the youngest and oldest plantations. Average tree heights would range from about 20 to 45 feet. After 60 years, diameters would range from 9 to 17 inches and height would range from 33 to 75 feet. After 60 years, large tree density (greater than 24 inches dbh) would average 18 trees per acre, which is 15% less than Alternative 1. As the trees continue to grow, canopy openings created by the Rim Fire would shrink, and in many cases, disappear as trees mature; therefore, fewer opportunities for conifer regeneration and development of understory vegetation would exist. As a result, horizontal and vertical forest structure would become more homogenized over time. Tree species composition would not significantly change in the absence of disturbance or thinning.

Stand Density Index

Reforestation

No reforestation activities would occur under Alternative 2, so discussion of SDI is limited to only portions of the project area that currently have natural conifer regeneration (9,825 out of 26,009 acres). While low levels of natural conifer regeneration outside these areas may occur, expansion of dry conifer forest into shrub dominated vegetation is slow (Barton 2002; Collins and Roller 2013; Goforth and Minnich 2008; Nagel and Taylor 2005; Roccaforte et al. 2012; Shatford et al. 2007), and would likely not qualify as conifer forest cover (greater than 10 to 25% conifer cover) according to CWHR criteria during the 60-year analysis time frame.

Overall, areas that are naturally regenerating within the project area increase in SDI rapidly because of the high densities of conifer seedlings. The highest densities are located in drainages and emergency travel routes. This is likely because these areas tend to be located in cooler, moister areas compared to mid-slopes and ridges; therefore, higher densities of white fir and Douglas-fir occurred in these areas prior to the Rim Fire. Within 20 to 30 years 385 acres of unsalvaged drainages and 31 acres of unsalvaged emergency travel routes would exceed a SDI of 300 and 365, respectively. After 40 years, a total of 2,940 acres would reach or exceed a SDI of 230 and 823 acres would exceed a SDI of 365. By year 60, all areas of natural regeneration would exceed a SDI of 230, of which, 38% would exceed a SDI of 365 and 23% would reach or exceed a SDI of 450.

The majority of the natural regeneration is white fir and Douglas-fir. These species tend to have a larger maximum SDI. Maximum SDI for ponderosa pine, white fir and Douglas-fir in Sierran mixed-conifer forests is 446, 634 and 570, respectively (Dunning and Reineke 1933). When factored together, maximum SDI for mixed species stands generally range from 524 to 533 for pine dominated stands and 584 to 592 for fir dominated stands (Long and Shaw 2012). Lower maximum SDI levels induced by bark beetles (Oliver 1995) are typically associated with even-aged pine dominated stands. Therefore, patches of fir-dominated natural regeneration should be able to tolerate higher SDI levels. Increased competition-, insect- and drought-related mortality would become more prevalent as SDI levels reached and exceeded 365 to 400 (i.e., about 60% of maximum SDI, Long and Shaw 2012), which would occur between years 30 and 40. Although white fir and Douglas-fir would tolerate higher SDI levels, ponderosa pine would not. The maximum SDI for ponderosa pine is 446 (Dunning and Reineke 1933); therefore, it would experience increasing rates of mortality over time. Ponderosa pine mortality would likely begin as early as 20 to 30 years from now when SDI levels near and exceed 60% of its maximum SDI. As a result, white fir and Douglas-fir would maintain a greater proportion of the conifer forest within the project area over the next 60 years; further departing from desired species composition and ecological integrity.

Existing Plantations

Of the existing plantations proposed for thinning, 3,904 acres currently exceed a SDI of 230 and about half of these acres exceed a SDI of 365. Without thinning, the existing plantations would exceed SDI levels of 230, about 20 years faster than compared to the other alternatives. By year 20, an additional 2,821 acres would exceed a SDI of 230. By year 40, a total of 7,997 acres would exceed SDI levels of 230. Thinning under the other alternatives would prevent most of these plantations from exceeding a SDI of 365. Without thinning, however, 7,596 acres would exceed SDI of 365 by year 60. That is, almost four times as many acres would exceed a SDI of 365 by year 60 compared to the other alternatives.

Without thinning, trees would not benefit from reduced stand densities, which would decrease water and nutrient availability to individual trees. Trees would experience slowed growth and reduced vigor, which would slow development of larger trees during the analysis time frame. Water stress during dry summers would intensify and tree mortality during periods of more severe drought would increase. As the trees increase in size and occupy more growing space over the next 20 to 60 years, SDI levels would increase to levels well beyond 365; the insect-induced SDI maximum (Oliver 1995; Oliver and Uzoh 1997). Subsequently, inter-tree competition would severely intensify and stands would likely show widespread evidence of insect-related mortality. Mortality would be more severe during periods of drought when trees are water-stressed. If insects and drought were not a factor, SDI levels would still be well beyond the threshold for self-thinning (50 to 60% of maximum SDI). At these densities competition-related mortality would be inevitable and result in “self-thinning” (Long and Shaw 2012). Like the other alternatives, mortality would typically occur in denser patches and on poorer sites where competition is more intense between trees; however, given the homogenous structure of such high tree densities, patches of mortality would likely be larger. Large patches of mortality would promote homogeneity of species composition and structure.

Future Management Feasibility

Reforestation

Overall, Alternative 2 would provide the fewest acres that might someday provide merchantable wood products for offsetting future management costs. Like Alternative 1, thinning criteria would not be met until about 50 years from now. Within the 9,825 acres that are expected to successfully regenerate with conifers, 1,504 acres would satisfy thinning criteria by year 50. Thinning would remove 4,451 board feet per acre. By year 60, an additional 6,062 acres would satisfy thinning criteria and remove 5,840 board feet per acre. After thinning to a SDI of 170, residual conifer densities would range from 140 to 222 conifers per acre. During the first 60 years, 2,259 acres never satisfy the thinning criteria despite most of these areas exceeding SDI levels of 400. Therefore, thinning to the target SDI of 170 would yield less than 2,000 board feet per acre, suggesting that small trees would still dominate these areas after 60 years. In total, Alternative 2 would result in 18,443 acres of suitable forest land that would not provide any cost offsets for future management.

Existing Plantations

As existing plantations increase in density, individual tree growth slows. Forgoing thinning would result in 15% fewer large trees (greater than 24 inches dbh) per acre. Similarly, fewer trees would reach merchantable sawtimber sizes during the next several decades and reduce potential opportunities to offset future costs associated with fuels reduction and wildlife habitat management.

Change in Forest Structure

Reforestation

Alternative 2 would rely on natural secondary succession to transition the excess of more than 30,000 early seral acres within the Rim Fire landscape into mid and late seral structures. Research suggests that high-severity fire creates vegetation conditions that promote more high-severity fire (van

Wagtendonk et al. 2012). Patterns of shrub dominance and abundant white fir regeneration indicate a shift away from a pine-dominated, frequent lower-severity fire system (Coppoletta et al. 2015; Crotteau et al. 2013). Given the uncharacteristically large patches burned by high-severity fire during the Rim Fire (Miller et al. 2009), transition into forest cover would be unpredictable and slow (Crotteau et al. 2013; Kozlowski 2002; Nagel and Taylor 2005). Intervention is required to help restore both pine composition and frequent fire as an ecological process (Crotteau et al. 2013; Harris and Taylor 2015). Without reforestation, substantial expansion of conifer forest beyond areas already regenerating would likely not occur until trees reach a size or age that can produce dependable cone crops. For white fir, which is the most abundant natural regeneration in the project area, this would likely not occur until 40 to 60 years from now (Laake 1990); at which time, newly established trees would likely experience slow growth and remain in an early seral structure well beyond the 60-year analysis timeframe. Additionally, conifer regeneration would mostly occur near existing seed sources (Bonnet et al. 2005), but some small numbers of seedlings could establish farther away in severely burn areas (Shatford et al. 2007). Considering the slow growth of seedlings once established among dense shrubs, however, these trees would likely require several decades to overtop shrubs and establish conifer forest (Nagel and Taylor 2005; Shatford et al. 2007). As a result, about 58% of the 23,492 acres (26,009 acres minus 2,517 acres of non-conifer cover types) proposed for reforestation would remain in an early seral structure dominated by shrubs and hardwoods during the next 60 years. This is about three times the proportion of the project area that would have historically occurred in an early seral structure (Safford 2013).

The naturally regenerating areas would experience slow tree growth due to competition with shrubs or high densities of other trees. Development of mid-seral conditions in these patches would also be slow and not emerge until sometime between 40 and 60 years from now. In the absence of disturbance, tree densities in patches of regeneration would remain high, so no open canopy condition would occur during the analysis time frame.

Existing Plantations

No thinning or prescribed fire in existing plantations would result in lower diversity of landscape forest structure during the next 60 years. Without treatment, closed canopy conditions would persist in the absence of disturbances. Areas that currently have open canopy structure because of the Rim Fire would eventually return to closed canopy conditions. Within 10 years all but about 750 acres is estimated to return to closed canopy conditions. Within the next 30 to 40 years no mid- or late-seral open canopy structure would exist.

CUMULATIVE EFFECTS

The ongoing, present and reasonably foreseeable future actions within the analysis area that do not cumulatively affect vegetation are the same as discussed under Alternative 1. Present activities occurring within the project area that do contribute to cumulative effects are also the same as those discussed in Alternative 1 and have already been accounted for in the description of the affected environment and discussion of direct and indirect effects under Alternative 2.

Change in Forest Structure

The present and foreseeable actions that may contribute to a cumulative effect to landscape forest structure are the same as discussed under Alternative 1; therefore, the following list discusses only the cumulative effects resulting from Alternative 2 in the context of the Rim Fire landscape. In total, Alternative 2 would contribute to the following cumulative changes to landscape forest structure:

- On NFS lands, early-seral conifer forest would be reduced from 44,975 acres to 35,150 acres after excluding the estimated 9,825 acres naturally regenerating. The remaining early-seral forest makes up about 34% of the conifer forest on NFS lands (102,618 acres) within the Rim Fire perimeter, which is significantly greater than the 15 to 20% historic range for early-seral structure

(Safford 2013). About half (17,163 acres) of these early-seral acres are comprised of complex early seral forest resulting from high-severity fire (not including areas of moderate burn severity).

- Post-Rim Fire early-seral conifer forest would be reduced from 71,552 acres to 46,248 acres. This includes 15,479 acres of reforestation on private lands and the 9,825 acres of natural conifer regeneration on NFS lands. The remaining early-seral forest makes up just over 25% of the Rim Fire landscape (including private land, Yosemite National Park and other public lands), which is greater than the 15 to 20% historic range for early-seral structure (Safford 2013).
- Complex early seral forest created by high-severity fire (not including areas of moderate burn severity) would remain at 34,499 acres, which makes up about 19% of the Rim Fire landscape (including private land, Yosemite National Park and other public lands). This is almost equal to the maximum of the 15 to 20% historic range for early-seral structure (Safford 2013).
- Future mid-seral closed canopy conditions would increase on up to 25,304 acres. This includes the plantations on private land and natural regeneration on NFS lands. Eventually these plantations and patches of conifer regeneration would make up about 14% of the future Rim Fire landscape, which is within the historic estimate of 5 to 15% (Safford 2013). This is assuming no thinning or stand replacing disturbance occurs within the next 60 years. Future thinning could transition these areas into open canopy structures and accelerate the development of late-seral open canopy forest. Historically, 1.5 to 2 times the amount of mid seral open forest existed than is present now. Late seral open canopy currently has the greatest deficit; historically, there were about 6 to 11 times more than currently exists. Without planting on NFS lands, development of future mid and late seral structures would be limited to the new plantations on private lands and natural regeneration on NFS lands. Assuming no stand-replacing events, these plantations and patches of forest would make up at most one third of the 45 to 75% of the Rim Fire landscape that should be in a mid to late seral open canopy condition (Figure 3.13-2).
- Mid and late seral open canopy structure would increase up to 5,272 acres resulting from other green thinning. Thinning accelerates development of open canopy conditions, which are lacking across the Rim Fire landscape. Thinning projects would increase the open canopy structure across the Rim Fire landscape by up to about 3%, which is less than Alternative 1.

Alternative 3

DIRECT AND INDIRECT EFFECTS

Tree Size and Species Composition

Reforestation

Alternative 3 would reforest the same number of acres as Alternative 1, but planting patterns and densities would differ (2.02 Alternatives Considered in Detail). Although Alternative 3 has fewer planting patterns than Alternative 1, it has a larger range of conifer planting densities. Alternative 3 would plant more acres at higher initial densities than Alternative 1; however, no herbicides would be used. Only manual release treatments are proposed under this alternative. Despite a greater number of acres being site prepped with deep tilling and forest cultivation, planted conifers under Alternative 3 would likely experience higher rates of initial mortality. Based on survival exams from the Mi-Wok and Groveland Ranger Districts, areas site prepped with deep tilling would have better survival than areas that did not. Deep tilling kills above-ground portions of shrubs and breaks-up below-ground roots and rhizomes (McDonald et al. 2004), reducing initial competition for water during the first growing season after planting. Based on past experience on the Stanislaus, conifer survival is estimated at 50% of the initial planting density in areas prepped with deep tilling and cultivation when followed by manual releases as shown in Table 3.13-4. Experience on the Stanislaus has also shown that manual releases without deep tilling result in much lower initial survival rates of about 30% (Table 3.13-4). After accounting for initial seedling mortality and oak buffers, conifer density during the first decade would range between 41 and 172 trees per acre and decline to 38 to 162 trees per acre over the next 60 years as displayed in Table 3.13-11. Alternative 3 would have similar oak and hardwood sizes and densities as Alternative 1. The effect of planting pattern on the development of fine-scale heterogeneity is similar to Alternative 1. Planting patterns would create open stand structures with small clumps of seedlings and saplings in the short-term; however, variation in tree sizes, ages and spatial distribution would require several decades at a minimum to develop.

Table 3.13-11 Alternative 3: Tree Density and Characteristics at Years 10, 20 and 60

Species	Year	PCR Mean	CBH Mean	DBH Mean	DBH Minimum	DBH Maximum	Height Mean	Height Minimum	Height Maximum	TPA Mean	TPA Minimum	TPA Maximum
Conifers	10	92.3	0.4	0.4	0.0	0.8	5.3	1.7	7.5	120	41	172
Conifers	20	67.0	5.4	2.8	0.1	4.8	16.3	4.7	24.2	120	40	172
Conifers	60	63.8	24.5	13.6	5.1	26.8	67.6	25.0	102.2	112	38	162
Hardwoods	10	82.7	1.9	1.3	0.6	2.9	10.7	7.8	21.0	50	38	63
Hardwoods	20	64.9	9.1	4.4	3.0	6.2	26.0	19.1	32.9	19	14	25
Hardwoods	60	42.7	25.2	7.2	4.2	11.5	44.0	27.3	61.1	17	13	23

PCR=percent crown ratio; CBH=canopy base height in feet; DBH=diameter at breast height in inches; TPA=trees per acre

Deep tilling and forest cultivation (DTFC) would primarily be completed in the late summer and fall, so conifers planted in the following spring would benefit from reduced competition until shrubs, grasses, and forbs recover. Areas that are not suitable for deep tilling and forest cultivation would be manually released either during planting or shortly thereafter. Water availability to young trees would be effectively diminished in areas that are not deep tilled as compared to areas that are deep tilled because the available water would be more easily consumed by shrubs with intact below-ground roots and rhizomes. Although not as effective as herbicide releases, repeated annual manual releases have proven fairly effective on most shrubs, grasses and forbs. McDonald and Fiddler (1997) evaluated different manual release treatments and determined that grubbing a radius of less than 5 feet around conifer seedlings significantly decreased conifer growth; however, multiple manual releases that removed vegetation within a 5-foot radius around conifer seedlings increased tree heights by about 1.5 times compared to a control. Creating only a 2-foot radius had no effect on tree growth. Growth projections made using RCONIFERS had similar results. Conifer heights at year 10 under Alternative 3 are about 1.5 times the heights estimated for Alternative 2. It should be noted, however, that tree heights in the McDonald and Fiddler (1997) study were about 14 feet after 10 years, which is considerably taller than the average height estimated for this analysis. This difference is likely a result of both site conditions and the large presence of bearclover within the Rim Reforestation project area. Bearclover was not present in the study conducted by McDonald and Fiddler (1997). Mechanical and manual releases have proven ineffective with bearclover (McDonald et al. 2004). Tappeiner and Radosevich (1982) found that trees grown in bearclover only achieved heights of about 6 feet after 19 years following a single herbicide application. While this was a slight increase over the control, multiple treatments are necessary to effectively control bearclover (McDonald et al. 2004). Tree heights estimated under Alternative 3, however, would average just over 16 feet after 20 years, which is similar to study plots with low shrub cover observed by McDonald and Abbott (1997). While not as tall as trees in Alternative 1, this is a large increase over Alternative 2 because hand-grubbing would provide some increase in water availability, albeit not as much as would occur with repeated herbicide applications. Taller average tree heights would also likely result from conifers growing in other shrub types where hand-grubbing would more effectively increase conifer growth compared to areas dominated by bearclover. Noxious weeds could rapidly establish in recently deep tilled or hand grubbed areas when mineral soil is exposed; therefore, conifer growth responses could be diminished if noxious weeds are present or if manual grubbing and pulling of known noxious weed treatments prove ineffective.

At year 20 when modeling is switched from RCONIFERS to FVS, tree growth rates artificially begin to match or even surpass rates in Alternative 1 because FVS does not account for shrub competition; however, shrubs would likely still impact tree growth beyond this age because shrubs would continue competing for water. Furthermore, by year 20 the average canopy base height under Alternative 1 is about 2 feet greater than Alternative 3. The average crown ratio is also less under Alternative 3. This suggests that trees under Alternative 1 are both taller and have larger crowns at year 20. Larger crowns indicate more needles (leaves) available for photosynthesis, which promotes faster height and diameter growth; yet, by year 60 the average dbh in Alternative 3 is almost the same as Alternative 1, suggesting that the sudden artificial release from shrub competition at year 20 (i.e., switching to FVS) contributed to sudden increases in height and diameter growth.

A hurdle related to Alternative 3 worth noting is the high cost and difficulty associated with effectively completing manual releases. The cost analysis is displayed in 3.10 Society, Culture and Economy. Manual release is difficult work and labor intensive, making it expensive, especially given the large number of acres that would require this treatment. Past experience on the Stanislaus has demonstrated the difficulties involved with manual release. Many contracts went into default during the 1990s and volunteer groups were only able to complete small areas, resulting in much of the work never being completed (USDA 1995).

Although Alternative 3 would result in lower conifer densities compared to Alternative 1, it would help increase conifer forest connectivity across a greater area than Alternatives 2 and 4. Alternative 3 would ensure that shade-intolerant species such as ponderosa pine and sugar pine make up a larger proportion of tree composition. Planting would increase the likelihood of suitable microsites across the project area being occupied by conifers rather than by indefinitely persisting shrubs and hardwoods. Establishing conifers, especially pine species, across a wider area, would increase the likelihood of more forest patches escaping future stand-replacing events, such as wildfire. As a result, conifers would be positioned to move and adapt to future changing climate conditions and disturbances as discussed under Alternative 1.

Effects of prescribed burning in young plantations would be the same as Alternative 1.

Existing Plantations

Same as Alternative 1.

Stand Density Index

Reforestation

Variable density planting is proposed on all mid-slopes and drainages outside SFMAs. Initial densities of variable density planting are higher than within SFMAs and features. Additionally, areas that are deep tilled are expected to have higher initial seedling survival. Although Alternative 3 would plant higher tree densities initially than Alternative 1, initial seedling mortality is expected to be much higher without the use of herbicides; therefore, tree densities on average would be lower than Alternative 1 and take longer to reach SDI levels of 230 and greater. Areas of higher planting densities and survival would require less time until the onset of inter-tree competition. These areas include drainages and mid-slopes that are deep tilled; however, no plantations would reach or exceed a SDI of 230 until sometime between years 50 and 60. After 60 years, 8,159 acres would exceed a SDI 230. The highest SDI at year 60 would be 272. Although the majority of the project area would not exceed a SDI of 230 within the next 40 to 50 years, low SDI levels suggest lower tree canopy cover and increased shrub cover. As temperatures and summer water deficits increase with changing climate, risk of insect-, competition-, and drought-related mortality would be slightly lower than Alternative 1 overall. Having lower SDI levels would improve tree resilience during periods of extended drought; however, increased shrub cover would increase the risk of high-severity fire during extreme drought (Harris and Taylor 2015; Lydersen et al. 2014).

Existing Plantations

Same as Alternative 1.

Future Management Feasibility

Reforestation

Low initial survival and initial planting densities would require longer periods of time for plantations to reach and exceed a SDI of 260. With lower tree densities, Alternative 3 would require larger trees to satisfy thinning criteria for SDI. While manual release treatments would improve tree growth compared to Alternative 2, they are not as effective as herbicide release treatments. Therefore, slower initial tree growth would further prolong the development of larger trees. Unlike the other alternatives, no plantations would satisfy the thinning criteria within the next 50 years. By year 60, a total of 8,136 acres would satisfy the thinning criteria. Thinning could remove 5,937 board feet per acre, which is more than could be removed under Alternative 2 and less than Alternative 1 in year 60. Residual conifer densities in these areas would range from 103 to 106 conifers per acre. Like Alternative 1, areas that satisfy the thinning criteria are those that initially have higher tree densities. These areas are the drainages and mid-slopes that are deep tilled during site preparation. The fuelbreaks, primary ridges, emergency travel routes and all areas that are not site prepped with deep tilling never satisfy the thinning criteria within the next 60 years because tree densities are too low. Alternative 3 would result in 17,873 acres of forest land that would not provide any cost offsets for future management.

Existing Plantations

Same as Alternative 1.

Change in Forest Structure

Reforestation

Alternative 3 would reforest the same number of acres as Alternative 1; however, the development of diverse forest structures would be dissimilar because of the different planting patterns, lower initial seedling survival and slower tree growth. Over the course of the next 30 years, not all plantations would progress from early seral successional classes into mid seral classes. About 58% would qualify as mid seral open canopy, while 42% would remain in an early seral structure. By year 40, fuelbreaks and primary ridges (1,146 acres total) would remain in an early seral condition with average tree sizes of 1 to 6 inches dbh and low tree densities. The other plantations would have reached a mid-seral condition with 10 to 39% canopy cover. After 50 years all of the plantations would reach a mid-seral condition. About one third would develop closed canopies and the other two thirds would have open canopy conditions (less than 40% canopy cover). Between years 50 and 60 additional plantations would develop closed canopy conditions, but a small portion (2,702 acres) would retain open conditions with less than 40% canopy cover. Compared to Alternative 1, a greater proportion of the project area would maintain an open canopy condition throughout the next 60 years and have smaller tree sizes on average. As described under Alternative 1, future management and disturbances would transition plantations into various successional classes.

Existing Plantations

Same as Alternative 1.

CUMULATIVE EFFECTS

The cumulative effects to vegetation under Alternative 3 are the same as Alternative 1, with the following differences.

- Manual release treatments are proposed instead of herbicide applications and more acres of deep tilling with forest cultivation are proposed. These differences would not contribute to a cumulative effect to vegetation outside of the project area. Present activities occurring within the project area that do contribute to cumulative effects include the Rim Fire Recovery and Rim Hazard Tree projects. These projects include various types of mechanical operations that would reduce natural conifer regeneration and understory vegetation. These effects have already been accounted for in the description of the affected environment and discussion of direct and indirect effects under Alternative 3.

- Differences in planting density and conifer growth would result in slower development of mid-seral structures as well as closed canopy structures; however, proportional changes in early-seral and complex early seral structures would be the same as discussed in Alternative 1.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Tree Size and Species Composition

Reforestation

In addition to the estimated 9,825 acres that are expected to naturally regenerate with conifers, Alternative 4 would reforest 2,954 acres using a founder stand planting design. Planting founder stands would allow control of competing vegetation and species composition. Trees planted in founder stands would grow faster than naturally regenerating conifers and increase the proportion of pine across the project area to 24%, 27% and 30% over the next 10, 20 and 60 years, respectively.. Founder stands would occur only on mid-slopes and consist of 2 to 10 acre patches of planted conifers. Founder stands would not be planted in areas with hardwoods. Similarly, planting would not occur if natural conifer regeneration is present. Table 3.13-12 summarizes tree characteristics and densities at years 10, 20 and 60. The use of herbicides would reduce competition in founder stands and result in similar average conifer dbh and heights as expected under Alternative 1. Outside of founder stands, however, competing vegetation would slow tree growth. When averaged together, the overall tree size of Alternative 4 would be considerably smaller than Alternative 1.

Table 3.13-12 Alternative 4: Tree Density and Characteristics at Years 10, 20 and 60

Species	Year	PCR Mean	CBH Mean	DBH Mean	DBH Minimum	DBH Maximum	Height Mean	Height Minimum	Height Maximum	TPA[1] Mean	TPA[1] Minimum	TPA[1] Maximum
Conifers	10	88.2	0.5	0.2	0.0	1.1	3.8	1.4	9.1	469	131	6,506
Conifers	20	61.8	5.0	1.9	0.0	7.0	13.1	3.4	32.6	401	131	2,373
Conifers	60	49.3	29.6	9.6	3.3	25.5	58.5	17.6	110.4	293	122	814
Hardwoods	10	83.3	2.0	1.8	0.5	3.7	12.1	6.9	23.7	53	38	104
Hardwoods	20	58.6	10.5	4.2	2.1	6.0	25.5	17.7	32.0	20	14	37
Hardwoods	60	39.7	26.0	6.8	3.5	11.4	43.2	27.3	53.6	15	5	24

PCR=percent crown ratio; CBH=canopy base height in feet; DBH=diameter at breast height in inches; TPA=trees per acre
[1] Trees per acre is based acres with natural conifer regeneration and founder stands, and does not include acres without regeneration.

Prescribed fire is proposed on a large scale under Alternative 4, within and outside of founder stands. At the earliest, prescribed fire would occur about 5 to 7 years after the Rim Fire. Although prescribed fire would reduce shrub cover, tree growth during these early years would have already been negatively impacted by competing vegetation. It has been well substantiated that suppressing competing vegetation during the first few years of tree development has the greatest impact on the survival and growth of conifer seedlings (Balandier et al. 2006; McDonald and Fiddler 2010). Growth lost during the first few years of seedling development will likely never be made up because seedlings do not respond as vigorously to delayed release treatments (McDonald and Fiddler 2001). Large-scale prescribed fire would, however, reduce surface fuels and tree densities where conifers are regenerating. Lower fuel loads and tree densities would help prolong the probability of another high-intensity fire, providing a longer window of opportunity for conifers to develop fire resilient characteristics such as thick bark and high canopy base heights. Trees growing in founder stands would develop these characteristics faster than trees outside founder stands. The early slow growth of trees outside founder stands would result in substantially smaller trees after 20 years than within founder stands. However, the area planted as founder stands is considerably smaller than the area naturally regenerating. Therefore, the overall averages for tree size and other characteristics increase very little compared to Alternative 2. As a result, the overall average canopy base height under Alternative 4 is still about 2 feet less than Alternative 1. The overall averages for dbh and height under Alternative 4 are also significantly less than Alternative 1.

Creation of founder stands throughout the project area would eventually lead to broader expansion of conifer forest throughout the large severely burned areas. Based on tree age and growth model projections, white fir would likely reach necessary tree sizes for dependable seed production before ponderosa pine. Within about 40 to 60 years, founder stands would likely have trees that are producing large, dependable cone crops that could then result in accelerated seed dispersal into adjacent areas. Although founder stands would have higher proportions of pine compared to naturally regenerating areas, white fir would still start producing more viable seed before any pine species; and therefore, would likely maintain dominance beyond the next 60 years.

Within founder stands, the effect of planting pattern on the development of fine-scale heterogeneity is similar to Alternative 1. Planting patterns would create open stand structures with small clumps of seedlings and saplings in the short-term; however, variation in tree sizes, ages and spatial distribution would require several decades at a minimum to develop. A key difference, however, is the small size of founder stands. The concept of a founder stand is to provide a seed source from which conifer forest can grow and expand. Founder stands are expected to require at least 40 to 60 years before substantial seed production begins and forest expansion is possible; therefore, Alternative 4 would likely require a longer period of time to establish conifer vegetation-disturbance dynamics, such as the ICO structures maintained by frequent fire, on a scale greater than 2 to 10 acres (i.e., the size of a founder stand).

Like Alternatives 1 and 3, the distribution of founder stands across the landscape would provide for a small level of ecological buffering that increases the probability of all conifer stands in the project area being lost to future disturbance (Millar et al. 2007). Planting small stands with ponderosa pine and sugar pine will provide a small level of planting redundancy that will disperse these species across a wider area than Alternative 2, and provide future seed sources. The founder stands would provide opportunities for these species to move and adapt to future changing climate conditions and disturbances, but to a lesser extent than Alternatives 1 and 3. The founder stands only increase the forested area by 2,954 acres compared to Alternative 2. Therefore, the founder stands would be dispersed throughout 13,230 acres of predominantly shrub and hardwood vegetation. Shrub cover is a good predictor of fire behavior (Lydersen and North 2012; van Wagtendonk et al. 2012). Under low live fuel moisture conditions, shrub patches can burn at higher intensity than fuels in surrounding forest vegetation (Knapp et al. 2012; Skinner and Taylor 2006). Today, prescribed burning and managed wildfire are faced with numerous operational and social constraints that limit their use in effectively reducing hazardous fuels and maintaining natural processes (Quinn-Davidson and Vaner 2012). If prescribed fire is not repeatedly used across the landscape to maintain low shrub levels, then the risk of high-severity fire killing founder stands would increase over time and limit their ability to function as sources for conifer dispersal in the long-term.

Existing Plantations

Same as Alternative 1.

Stand Density Index

Reforestation

Outside of founder stands, the direct and indirect effects related to SDI are the same as described for Alternative 2. Founder stands would only account for 2,954 acres of small plantations distributed across the project area. Planting density within founder stands would range between 100 and 200 trees per acre. At tree densities this low it would require almost 60 years to exceed a SDI of 230. As temperatures and summer water deficits increase with changing climate, risk of insect-, competition-, and drought-related mortality would be low within founder stands during the first 50 years. Having lower SDI levels would improve tree resilience during periods of extended drought; however, lower tree densities would increase the abundance of shrub cover within founder stands. Given the small size of founder stands, they would likely be adjacent to shrub dominated patches that have not been reforested. In the absence of frequent prescribed fire, shrubs would likely reach decadent structures after 10 to 20 years (Shatford et al. 2007). Saspis and Brandow (1997) concluded that one of the factors contributing to high-severity fire risk in the Granite plantations was the juxtaposition of different fuel types and ladder fuels. Therefore, increased shrub cover would increase the risk losing founder stands to high-severity fire during extreme drought (Harris and Taylor 2015; Lydersen et al. 2014).

Existing Plantations

Same as Alternative 1.

Future Management Feasibility

Reforestation

The effects of Alternative 4 are the same as Alternative 2. Although founder stands would increase the acres of reforested land by 2,954 acres, SDI levels would not reach a SDI of 260 within the next 60 years; therefore, no additional acres would satisfy the thinning criteria and no additional cost offsets would be realized for future management.

Existing Plantations

Same as Alternative 1.

Change in Forest Structure

Reforestation

With the exception of prescribed fire and creating founder stands, Alternative 4 would have similar effects on landscape forest structure as Alternative 2. Widespread use of prescribed fire could promote establishment of conifer regeneration in large areas that would otherwise remain dominated by shrubs and hardwoods. Prescribed fire would create openings in the shrub canopy where conifer seedlings could establish; however, reinvasion of conifers would still rely on complex interactions between seed supply, suitable medium for seed germination and favorable climatic conditions (Bonnet et al. 2005; Kozlowski 2002). A high abundance of white fir and Douglas-fir regeneration after the Rim Fire suggests that these species would have the highest probability of establishing after prescribe fires, so a desirable species composition would likely not be achieved within the next 60 years. Furthermore, high shade provided by residual mature conifers in a low- to moderate-severity fire system reduces shrub cover, limiting competition with conifer seedlings (Crotteau et al. 2013). While prescribed fire in large severely burned areas would create openings in shrub cover, most of these areas would have no conifer canopy to slow the response of shrub growth following prescribed fire. Consequently, shrub cover would quickly return and suppress any newly established conifers; thus, prolonging succession from shrub to conifer (Crotteau et al. 2013; Nagel and Taylor 2005; Shatford et al. 2007). While succession from early seral to mid-seral conditions would still likely occur on the order of multiple decades, frequent prescribed fire could accelerate transition from shrub cover to conifer cover quicker than Alternative 2, but the difference is difficult to quantify.

Founder stands would have no effect on the complex early seral forest remaining within the project area after Rim Recovery and Rim HT project work is fully completed. Herbicide use in founder stands would reduce competition with understory vegetation and promote faster conifer growth. Founder stands would reach a mid-seral open canopy condition by year 30, which would likely be the only mid seral conditions within the project area (2,954 acres). After 40 years an additional 7,087 acres that naturally regenerated would reach mid seral tree sizes. Given the low initial tree densities in founder stands, they would require about 50 years before trees reach a size that created a closed canopy (greater than 40% canopy cover). By year 60 all founder stands and all patches of white fir and Douglas-fir dominated natural regeneration would reach a mid-seral closed canopy condition. In total, 54% of the 23,492 acres (26,009 acres minus 2,517 acres of non-conifer cover types) proposed for reforestation under the other action alternatives would remain primarily dominated by shrubs and hardwoods after 60 years. This is more than twice the proportion of the project area that would have historically occurred in an early seral structure (Safford 2013).

Existing Plantations

Same as Alternative 1.

CUMULATIVE EFFECTS

The cumulative effects to vegetation caused by thinning existing plantations are the same as described under Alternative 1.The cumulative effects to vegetation caused by reforestation activities are the same as Alternative 2, with the following differences.

- Creating founder stands would increase the proportion of early seral forest that is transitioned to a mid-seral structure within the 60-year analysis time frame. In total, Alternative 4 would contribute to a cumulative reduction of early seral forest from 71,552 to 43,294 acres. This includes 15,479 acres of reforestation on private lands, 9,825 acres of natural conifer regeneration, and 2,954 acres of founder stands. The remaining early seral forest makes up about 24% of the Rim Fire landscape, which is greater than the 15 to 20% historic range for early seral structure (Safford 2013).
- Once founder stands develop into a mid-seral size, they would remain in an open canopy structure until year 50. Until that time, they would increase the proportion of open canopy structure across the Rim Fire landscape by 1.6%

Alternative 5

DIRECT AND INDIRECT EFFECTS

Tree Size and Species Composition

Reforestation

Alternative 5 would have similar tree sizes and species composition as Alternative 1 as shown in Table 3.13-13 and Table 3.13-9. Oliver (1979) found that seedlings spaced greater than 6 feet apart did not experience slowed growth during the first 12 years after planting. Although Alternative 5 has a higher initial planting density than Alternative 1, hand thinning would occur by year 7, reducing tree densities to about 220 to 240 trees per acre (about 14-foot spacing). Planting higher densities would initially ensure greater tree cover, which would increase the likelihood of trees being planted in favorable microsites (e.g., pockets of deep soil and high moisture availability), that might otherwise be passed over when planting seedlings farther apart.

Table 3.13-13 Alternative 5: Tree Density and Characteristics at Years 10, 20 and 60

Species	Year	PCR Mean	CBH Mean	DBH Mean	DBH Minimum	DBH Maximum	Height Mean	Height Minimum	Height Maximum	TPA Mean	TPA Minimum	TPA Maximum
Conifers	10	94.4	0.4	0.7	0.0	1.4	7.4	2.9	10.7	231	211	236
Conifers	20	70.5	7.0	4.3	0.1	7.2	23.6	5.1	38.1	232	211	236
Conifers	60	58.8	31.0	13.5	4.2	24.6	75.2	24.0	121.3	192	179	201
Hardwoods	10	79.8	2.1	1.2	0.1	2.5	10.2	5.5	20.3	50	38	63
Hardwoods	20	44.2	13.0	3.9	2.0	6.2	23.3	14.1	35.8	20	15	25
Hardwoods	60	29.3	26.9	6.0	3.4	10.2	38.1	20.9	53.8	12	10	18

PCR=percent crown ratio; CBH=canopy base height in feet; DBH=diameter at breast height in inches; TPA=trees per acre

Within the first several years, trees growing in more favorable conditions would have larger diameters and be taller. Thinning would favor the most vigorous trees, removing trees growing in less productive pockets. Thinning the slower growing trees would avoid a systematic thinning and begin moving the plantations toward a more random spatial distribution that is expressed through microsite productivity. Like all the other action alternatives, young plantations would still have a homogeneous vertical structure. Vertical structure would not begin to express itself until trees reach an age or size when natural regeneration begins and new cohorts are established. This would be the case for all alternatives, whether vegetation is dominated by shrubs or conifers. Alternative 5 would also have relatively the same effects as Alternative 1 in terms of future ecological resiliency, adaptation and diversity. Effects of herbicide applications for conifer release and noxious weed treatments would be the same as Alternative 1.

Existing Plantations

Same as Alternative 1.

Stand Density Index

Reforestation

Only one planting pattern is proposed under Alternative 5, but mortality and thinning, occurring at about age 7, would begin introducing horizontal complexity. After accounting for initial mortality, oak buffers and thinning, tree densities would average about 230 trees per acre. This is somewhat higher than Alternative 1, so SDI levels would increase faster. By year 40, the majority of the project area would near a SDI of 230, but not exceed it. By year 50, however, all plantations would exceed a SDI of 230. At this point, plantations would show an increase in insect-, competition- and drought-related mortality. Assuming no thinning or other disturbances occur, all plantations would exceed a SDI of 300 by year 60, but not 365. The highest SDI achieved by year 60 would be 337 (about 64% of maximum SDI). Because all of the plantations would exceed a SDI of 230 by year 50, a greater number of acres would experience increased stress during periods of extreme drought compared to the other alternatives. As plantations approach and exceed SDI levels of 300, self-thinning would occur and SDI would decrease; however, higher tree densities would shade the forest floor and decrease shrub cover continuity. Lower shrub abundance would potentially result in more patches of conifers escaping high-severity fire, especially in cool and moist areas (Harris and Taylor 2015; Lydersen et al. 2014).

Existing Plantations

Same as Alternative 1.

Future Management Feasibility

Reforestation

Higher tree densities under Alternative 5 would result in all plantations meeting thinning criteria by year 50. Although tree densities are slightly higher than Alternative 1, both alternatives have about the same average tree sizes throughout the 60-year analysis time frame. Therefore, Alternative 5 would have more merchantable sized trees in year 50 and remove more board feet per acre sooner than all the alternatives. Residual conifer densities would still be somewhat higher than Alternative 1, ranging from 122 to 142 conifers per acre. A larger per acre volume is removed under Alternative 1 in year 60. This is partially a result of the 10-year cycles that FVS is based on. A large portion of the acres thinned under Alternative 1 in year 60 are close to a SDI of 260 in year 50 and would likely exceed this threshold well before 60 years. Because FVS works on 10-year cycles, these acres would continue to grow and accumulate volume over the course of several years despite exceeding a SDI of 260; therefore, more volume would be removed per acre in year 60. Similarly, waiting to thin until year 60 under Alternative 5 would result in larger per acre volume removed than Alternative 1, just as it did at year 50. Waiting until year 60 would also result in lower residual tree densities as it did with Alternative 1. While greater risk would be taken on if thinning were postponed 10 more years, SDI levels would still be well below the bark beetle induced maximum of 365 (Oliver 1995; Oliver and

Uzoh 1997). As a result, Alternative 5 provides future generations more management options earlier across more acres.

Existing Plantations

Same as Alternative 1.

Change in Forest Structure

Reforestation

Alternative 5 would have similar effects as Alternative 1 on forest landscape structure over the next 60 years. Key differences would include less variation in canopy cover compared to Alternative 1. All plantations under both alternatives would reach mid seral structures within the next 30 years. Unlike Alternative 1, however, canopy cover would only vary between 40% and 59% as opposed to 20% to 59%. By year 50, canopy cover would increase in all plantations to greater than 60%. Under Alternative 1, the first, but not all, plantations would reach a canopy cover of greater than 60% by year 60. Canopy closure is accelerated under Alternative 5 because of higher initial planting densities. As described under Alternative 1, future management and disturbances would transition plantations into various successional classes.

Existing Plantations

Same as Alternative 1.

CUMULATIVE EFFECTS

The cumulative effects to vegetation caused by Alternative 5 are the same as Alternative 1, with the following difference. Higher planting density would result in faster development of closed canopy structures in some areas; however, proportional changes in early seral and complex early seral structures would be the same as Alternative 1.

Summary of Effects Analysis across All Alternatives

Tree Size and Species Composition

Alternatives 1 and 5 would have higher conifer survival and faster growth because herbicide applications would more effectively control competing vegetation compared to other alternatives. As a result, they would have the largest average conifer dbh after 20 years as well as throughout the next 60 years. Herbicides are proposed under Alternative 4 for use in founder stands, which would experience similar dbh and height growth as plantations in Alternatives 1 and 5; however, when averaged with tree growth outside founder stands, growth is less. Manual release treatments in Alternative 3 would not control competing vegetation as effectively as herbicides; therefore, Alternative 3 would experience higher initial mortality rates and slower conifer growth compared to Alternatives 1 and 5. Alternative 2 would not control competing vegetation and would experience the slowest conifer growth.

Alternatives 1, 3 and 5 would have more control over tree species composition. Table 3.13-14 and Table 3.13-15 show these alternatives would promote a higher proportion of ponderosa pine and sugar pine across the landscape. Alterative 2 would rely on natural regeneration; and therefore, white fir and Douglas-fir would comprise the largest proportion of future stands in the project area. Founder stands in Alternative 4 would increase the proportion of pine species across the project area, but the increase would be marginal given the small number of acres planted and the abundance of white fir and Douglas-fir outside founder stands.

Herbicide and manual release treatments would decrease the abundance of shrub cover throughout the project area. Reductions in shrub cover are expected to last for about 5 years at which time they would begin to recover and increase in abundance over the next 15 to 20 years until conifer canopies begin to close and shade the forest floor.

Thinning existing plantations would decrease tree density and increase health and vigor of residual trees. By year 60, thinned plantations would increase the number of large trees (trees greater than 24 inches dbh) by about 15%. Over the next 60 years, tree diameter would increase across all thinned plantations, with averages ranging from about 18 to almost 31 inches dbh in the youngest and oldest plantations. Average tree heights would range from about 60 to 105 feet. Alternative 2 would not thin existing plantations; therefore, higher tree densities would slow tree growth. After 60 years, average tree diameter would increase by about 50% less than if thinned. Average tree height heights would also increase by 30 to 50% less than if thinned.

Stand Density Index

Areas that initially have the highest tree densities would develop higher levels of SDI sooner than areas with lower initial tree densities. Although Alternatives 2 and 4 would have fewer acres of conifer forest, patches of unmanaged natural conifer regeneration would exceed SDI levels of 230 and 365 much faster than would occur under the other alternatives. About 30% of conifer forest under Alternatives 2 and 4 would exceed a SDI of 230 by year 40 and about 6 to 8% would exceed a SDI of 365 by year 40. No plantations under the other alternatives would exceed a SDI of 230 within 40 years. Therefore, conifer forest under Alternatives 2 and 4 would likely begin experiencing effects of insects, competition and drought before plantations in the other alternatives. Prescribed fire in Alternative 4 could slow the increase of SDI, but it is difficult to quantify the effect of fire given the high shrub cover expected under this alternative. Founder stands in Alternative 4 and plantations in Alternatives 1, 3 and 5 never reach a SDI of 365 or more. Table 3.13-14 and Table 3.13-15 show, by year 60, most of the plantations in Alternative 1 and all of the plantations in Alternative 5 exceed a SDI of 230. Low initial survival and tree densities in Alternative 3 reduce the number of acres that reach a SDI of 230. By year 60 only 31% of Alternative 3 plantations exceed a SDI of 230.

Thinning existing plantations would reduce SDI levels and increase resiliency to insect-, drought-, and competition -related mortality. The plantations would benefit from reduced competition for a period of 20 to 40 years. During this time, residual trees would increase in size and SDI would slowly increase again. No thinning would occur under Alternative 2 and the existing plantations would experience higher levels of insect, drought, and competition related mortality sooner.

Future Management Feasibility

Alternatives 1 and 5 would provide the most potential for offsetting future management costs by harvesting intermediate sized trees. Table 3.13-14 shows reforestation activities under Alternatives 1 and 5 result in the most merchantable sized trees within the next 50 years, without first exceeding SDI levels that would result in wide spread insect, drought, and competition related mortality.

Slightly higher tree densities in Alternative 5 results in all plantations reaching a SDI that requires thinning by year 50, while some plantations in Alternative 1 would not reach as high of SDI levels in this time frame. Therefore, all plantations could be commercially thinned by year 50 under Alternative 5. Sometime between years 50 and 60, the remaining plantations in Alternative 1 would need to be thinned. Allowing the trees to accumulate volume for an additional 10 years would result in more volume being removed per acre. Low initial seedling survival and low planting densities in some areas would result in far fewer acres requiring thinning within the next 50 to 60 years; therefore, while trees would grow to a merchantable size, too few would exist to warrant harvesting and less cost offsets for future management. Very high tree densities in Alternative 2 would result in slow tree growth over the next 60 years. Some areas would eventually have trees that are of merchantable size; however, many trees would be too small to be commercially harvested even 60 years from now. Although founder stands in Alternative 4 would grow to commercial size, tree densities would be too low to commercially harvest and provide no cost offset for future fuels reduction and wildlife habitat management.

Table 3.13-14 Comparison of Alternatives: Summary of Vegetation Effects for Reforestation

Indicator	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3	Alternative 4	Alternative 5
Average conifer dbh at year 20 (inches)	4.3	1.7	2.8	1.9	4.3
Average conifer height at year 20 (feet)	23.2	12.4	16.3	13.1	23.6
Percent conifer in pine	70	23	70	27	75
Percent conifer forest exceeding stand density index of 230 at year 60	90	100	31	100	100
Percent conifer forest exceeding stand density index of 365 at year 60	0	38	0	29	0
Future potential timber yield (mmbf)	163	42	48	42	160
Acres reforested	26,009	9,825	26,009	12,779	26,009
Acres not reforested	0	16,184	0	13,230	0

Table 3.13-15 shows thinning existing plantations would result in larger trees over the next 60 years compared to not thinning. Therefore, more merchantable intermediate-sized trees would exist in the future that could be harvested to offset future management costs.

Table 3.13-15 Comparison of Alternatives: Summary of Vegetation Effects for Existing Plantations

Indicator	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3	Alternative 4	Alternative 5
Average conifer dbh at year 20	18-31 inches with 15% more large trees (greater than 24) than Alternative 2	9-17 inches with 15% fewer large trees (greater than 24) than Alternative 1	Same as 1	Same as 1	Same as 1
Average conifer height at year 20	60-105 feet	33-75 feet	Same as 1	Same as 1	Same as 1
Tree species composition	Increase in sugar pine, white fir, Douglas-fir and incense cedar	Unchanged	Same as 1	Same as 1	Same as 1
Stand density index	Majority of acres reduced well below 230 for 20 to 40 years	Majority of acres maintained high levels well over 230	Same as 1	Same as 1	Same as 1
Forest structure	Heterogeneous open canopy	Homogeneous closed canopy	Same as 1	Same as 1	Same as 1

Change in Forest Structure

Alternatives 1, 3 and 5 would reforest 26,009 acres. While not every acre or even 100% of each acre would be reforested (e.g., oak patches, rock outcrops, sensitive plant areas), these alternatives would provide a relatively broad distribution of tree regeneration across more acres than Alternatives 2 and 4. In the long-term, it would promote greater species diversity in large areas that currently have little or no natural conifer regeneration. Large patches of shrubs and hardwood vegetation slow establishment of conifers and can require decades to centuries to convert from shrub-dominance to conifer forest (Collins and Roller 2013; Conard and Radosevich 1982a; Nagel and Taylor 2005; Wilken 1967). Planting conifers in areas that lack natural conifer regeneration would accelerate the development of conifer canopy and promote structural diversity in areas that would otherwise remain dominated by shrubs or hardwoods in the long-term. While Alternative 4 would provide opportunities for planting desirable conifer species, the total acres planted are far less than under Alternatives 1, 3 and 5. Currently an excess of early seral structure exists across the Rim Fire landscape. Alternatives 1, 3 and 5 would accelerate the establishment of conifer forest on more acres, which would move a larger proportion of the Rim Fire landscape toward mid and late seral forest structures that are currently lacking.

Thinning existing plantations would increase the acres of mid seral open canopy forest within the Rim Fire landscape. Thinning will also promote fine-scale heterogeneity by creating a range of canopy openings, tree clumps and individual trees. Not thinning the existing plantations would maintain closed canopy conditions, which are currently in excess across the landscape. Alternative 2 would also maintain homogeneous structures.

3.14 Visual Resources

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

FSM 2380 includes direction on application of the principles of landscape aesthetics, scenery management and environmental design in project-level planning. The Scenery Management System (SMS); Landscape Aesthetics, A Handbook for Scenery Management, Agriculture Handbook 701 (USDA 1995a) provides guidance on the scenery management system. The USDA Forest Service Landscape Management Series Volume 2, Chapter 1, The Visual Management System (VMS) provides guidance for development and application of Visual Quality Objectives (VQOs).

The Forest Plan goal for Visual Resources includes: Meet adopted VQOs on all projects. Maintain high visual quality in areas of concentrated public use and in areas seen from major travel routes. Allow management activities in certain areas to dominate the surrounding characteristic landscape, but they should borrow from natural forms and appear as natural occurrences when viewed from background distances. Consider private land concerns during the evaluation of proposed management activities adjacent to privately developed subdivisions and recreation areas. Particular attention will be given to visual quality in the foreground view areas of these private developments as well as any other values relating to their attendant use and enjoyment of the National Forest (USDA 2010a, p. 7).

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

Assumptions Specific to Visual Resources

- Forest lands within the project area met the VQOs prior to the Rim Fire, but burned areas may not currently meet the VQOs.
- Reforestation will improve the landscape aesthetics in the long-term, moving conditions towards meeting VQOs. This is compatible with the Forest Plan objective for Visual Resource Improvement (USDA 2010a, p. 63), commonly referred to as the Rehabilitation VQO.
- The terms visual/scenery resources and landscape characteristics all refer to visual resources.

Data Sources

- Forest Plan VQO maps
- GIS layers for Management Areas and VQOs

Visual Resources Indicators

- VQOs Achieved
- Degree of Natural Appearance

Visual Resources Methodology by Action

Although the Forest Plan direction for visual resources was developed using the VMS, the current direction is to apply the SMS. Therefore this analysis combines concepts from both systems. During field observations, a variety of photos were taken from various viewpoints. The photos of the existing condition were used in conjunction with descriptions of proposed activities to determine the extent and duration of potential impacts to visual resources.

This is a qualitative analysis that does not include acres of proposed activity by VQO. Proposed activities were analyzed based on their potential impacts to visual resources including the duration of impact, and the degree of natural appearance.

DIRECT AND INDIRECT EFFECTS

- The analysis area is the Rim Fire perimeter.
- Duration of short-term effects is 20 years; duration of long-term effects is 40 years.

CUMULATIVE EFFECTS

- The cumulative effects analysis area is the entire Rim Fire area including NFS lands and those under other ownership.
- The timeframe for the cumulative effects analysis is 40 years.

Affected Environment

Existing Conditions

The 2013 Rim Fire, the dominant visual impact within the project area, burned extremely hot, killing thousands of acres of conifer forest and leaving large expanses with little to no live vegetation. Re-sprouting and natural seeding is occurring, but the primary species returning to the landscape are sprouting shrubs such as bearclover, manzanita and ceanothus as well as oaks and other sprouting hardwoods. Historically, the Rim Fire landscape was railroad logged from the 1920s to 1940s and the forest was primarily composed of second growth pine and mixed conifer forest. Other past management activities within this landscape include timber harvesting/vegetation management, mining, grazing, transportation system construction, fire suppression, prescribed burning and fuels reduction. In addition, insect and disease occurrences along with drought related mortality occurred. These actions and events created a mosaic of forested areas interspersed with meadows and some pockets of hardwoods and conifers providing contrast and diversity to the dominant burned landscape.

The Forest has the highest recreation visitation rate of national forests on the Sierra Nevada western slope (3.08 Recreation). Viewing natural features, and driving for pleasure were listed among the top five recreation activities visitors participated in on the Forest based on results of the 2012 National Visitor Use Monitoring (NVUM) survey. Forest visitors typically are interested in or concerned about how the forest looks when viewed from developed recreation sites. Many popular developed recreation sites are located along the Evergreen Road where scenery is viewed from by visitors driving for pleasure and recreating. Forest Service developed day use sites include Carlon, Merals Pool, Middle Fork, Rim of the World and Rainbow Pool. Developed Campgrounds include Carlon, Cherry Valley, Dimond O, Lost Claim, Lumsden, Lumsden Bridge, Middle Fork, South Fork and Sweetwater. The Peach Growers Recreation Residence Tract, City of Berkeley Tuolumne Camp and San Jose Camp, operated under Special Use Permit (SUP), are also within the Rim Fire where users view the Forest. Evergreen Lodge and Camp Mather are private land recreation developed sites. Dispersed recreation users on non-motorized or motorized system trails also view the landscapes within the Rim Fire.

The Rim Fire resulted in a mosaic or patchwork of burned trees and shrubs with islands of green surviving trees and shrubs. Figure 3.14-1 shows the vast amount of burned landscape viewed immediately after the Rim Fire from the Rim of the World Vista looking north across the Tuolumne River canyon to Jawbone Ridge. In contrast, Figure 3.14-2 shows the majority of vegetation north of Rainbow Pool Day Use Area remained intact, but scattered dead trees are visible.

Regeneration of shrubs occurred quickly in most of the project area. Figure 3.14-3 displays the returning vegetation 2 growing seasons after the Rim Fire. Figure 3.14-4 shows lupine "meadows" quickly regenerating after the Rim Fire.

Figure 3.14-1 View from the Highway 120 Rim of the World Vista (October 2013)

Figure 3.14-2 Lightly Burned Landscape Surrounding Rainbow Pool Day Use Area (May 2015)

Figure 3.14-3 Shrub Regeneration after Two Growing Seasons (May 2015)

Figure 3.14-4 Lupine in Foreground with burned Oaks and Conifers in the Background (May 2015)

Environmental Consequences

Proposed activities may take about 10 years to implement and another decade for the planted trees to dominate the landscape. During implementation the Rehabilitation VQO applies to the project area. The proposed activities may be visible in all distance zones from popular developed recreation sites or roads and trails in the project area. Proposed activities that occur in the foreground and middle ground views would be most noticeable. Some of the proposed activities vary based on the scale or scope of the specific management activity. Over time as reforestation is accomplished, the modification VQO could be achieved. As the trees continue to grow, the VQOs Partial Retention and eventually Retention could be met. The Visual Report provides additional details.

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Plantations

Short-term direct effects of plantations (the first 5 years) including within deer habitat enhancement areas would occur when most trees are less than 10 feet tall and not very apparent in middle ground views. In foreground views the individual trees would be noticeable. Individual trees and plantations would not be noticeable in the background distance zone in this timeframe.

As the trees mature and become more obvious in the middle ground, the plantations would be more apparent and may look unnatural when viewed for a long duration of time. The homogeneous size of the trees when the plantations are between 15 to 20 years old and trees are 12 to 30 feet tall would look unnatural. Conifer seedlings would not be planted within 25 feet of oaks during the initial planting which would create an open park-like vegetative mosaic and enhance species diversity. As the number of surviving seedlings decreases all of the plantations would appear more natural with greater variety in the edges of the clumps and spacing of trees. This would improve the form and line of the clusters and overall diverse appearance of the units. The more varied the topography is in these planting areas the more natural the initial patterns would appear. Areas which could provide long duration views include developed recreation sites and trails and roads where visitors move slowly through the landscape. Plantation areas would appear natural when viewed from the background distance zone. Plantation patterns would be less noticeable the more undulating the topography is in all distance zones and over time.

Effects to visual resources include enhancing the meadow component of the vegetative mosaic by decreasing conifer encroachment in the long-term, retention of small clumps of conifers near the meadow and further away from the core of the meadow retaining larger clumps of conifers. This special meadow planting design would also add spatial variety into the stands while emphasizing oaks and other hardwoods. All VQOs would be met with implementation of this pattern.

Seedlings in fuelbreaks would be planted to approximately 13 to 17 foot-initial spacing for 150 feet on either side of the ridge with a 30-foot “no plant” strip along the ridge top. In middle ground and background views primary ridge and fuelbreak treatments would be similar in appearance to a ski area run or utility corridor if the 30-foot width is consistent and the edges do not vary. The inclusion of the 75-foot clearance for helispots would create diversity regarding the forms and lines of the vegetative mosaic. “To meet visual quality objectives successfully, fuelbreak design must subdue unnatural contrasts and borrow from natural form, lie, color and texture” (USDA 1985). In the long-term the maximum modification and potentially the modification VQOs would be met.

Long-term visual effects of plantations, after 20 years, would have diminished in the middle ground views and appear natural to forest visitors. Planting patterns would be less noticeable the more undulating the topography is in all distance zones and over time.

Natural regeneration typically occurs in random spacing with a natural diversity of species. This would result in naturally appearing forms, colors, textures, and stands free of unnatural linear features. All VQOs would be met in the long-term if natural regeneration occurs. Planting conifers would accelerate the recovery of these species and ensure their existence in the short and long-term which is consistent with the Rehabilitation VQO.

The proposed management activities to restore the vegetative mosaic within the Rim Fire are compatible with the interim Rehabilitation VQO. In the long-term implementation of the activities would appear natural eventually meet the forest plan VQOs.

As plantations mature and over time ecological processes including natural regeneration and mortality would occur and these areas would appear more natural. Commercial thinning could also create the desired ICO structure. Figure 3.14-5 displays a 50-year old plantation thinned from below without an ICO design, but different sized trees, species and an abundance of brush are still present in these stands.

Figure 3.14-5 Fifty-Year Old Pine Plantation (Wrights Creek Fire) Near the Rim Fire (May 2015)

Deer Habitat Enhancement and Thin Existing Plantations

Direct effects of thinning and removal of conifers near oaks include creating a more open park-like vegetative mosaic and enhance species diversity, tree sizes and heterogeneity across the landscape. These activities are compatible with the Rehabilitation VQO and would aid in the progression of restoring the landscape characteristics and enhancing the visual quality. “The amount of visual access, or how far one can see into a forest, also has been found to be a significant predictor of landscape preference… As the density of smaller trees increases, visibility and scenic beauty decrease.” (Ryan 2005). Clumping of conifers to increase hiding cover and creating larger openings for deer forage also creates additional visual variety in the stands, which would assist in meeting long-term VQOs. Thinning densely stocked stands improves and rehabilitates the scenic character of the forest and thinning to the ICO structure would create a naturally appearing stand.

Noxious Weed Eradication

Noxious weed eradication would decrease competition for native vegetation to naturally reclaim the landscape. All noxious weed treatments including application of herbicides would assist in the rehabilitation of the landscape to eventually meet the forest plan VQOs.

Reforestation

Site preparation including feller bunchers or other mechanical equipment would create visual resource effects including visible evidence of slash on the ground, soil disturbance and other signs of disturbance associated with use of machinery. This short-term effect would be visible for one or two growing seasons. "Residual woody debris is one of the most significant predictors of negative perception of scenic beauty" (Ryan 2005). Indirect effects forest visitors would experience from mechanical equipment include the sights, sounds, and smells of equipment operating in the Forest for several years. This work would be dispersed throughout the 25,000 acre area and be limited to specific units each season.

Deep tilling and forest cultivating (subsoiling) would be noticeable when viewed from all foreground and middle ground distance zones. With the re-growth of shrubs, grasses, wildflowers and other herbaceous plants the effects of deep tilling and forest cultivation would last about 2 growing seasons. Hand cutting, hand piling and prescribed burning would directly affect visual resources temporarily through evidence of slash on the ground and burned ground. The effects of pile burning would be less noticeable than broadcast or jackpot burning since piles would produce a more discreet foot print and area of smoke dispersion. Mastication would remove most of the shrub component in these areas, creating a strong contrast between soil colors and herbaceous plants in the landscape immediately after mastication has occurred. Within one to two growing seasons, the cut shrubs would re-sprout. The cut sprouting shrubs would return after 1 to 2 growing seasons to provide diversity and heterogeneity in these stands. This site preparation treatment would assist in meeting the long-term VQOs. Broadcast hand application of herbicides for site preparation and release would kill competing vegetation, but would leave it in place and intact on the site. Although this treatment is different than mastication the resulting effects to visual resources is essentially the same.

Prescribed Fire

Prescribed fire (broadcast burning and jackpot burning) would have short-term direct effects including the presence of black and charred vegetation and sometimes soils. "While prescribed burning can mimic natural disturbance, like a wildland fire it can leave a forest blackened and charred and is perceived negatively by the public" (Ryan 2005). This effect is overcome within one year, and would only be short-term as seen by the average forest visitor. Multiple prescribed burns may be ignited each season, but individual burns would not last more than several days. Long-term direct effects from broad scale, low to moderate intensity under burning in thinning units and surrounding locations would reduce fuel loading and promote regeneration of trees, shrubs, wildflowers and other herbaceous plants. This activity would diversify the vegetative mosaic in regards to vegetative forms, natural appearing lines, and additional colors and textures in the forest stands. Short-term indirect effects from prescribed burning include views of the fire and smoke, and forest visitors may smell the smoke.

Prescribed burns would be ignited during the spring and fall to re-introduce fire back into the plantations around age 10 as well as to under burn within the existing plantations prior to ICO thinning. The individual burns would not last long, however burning in the project area could occur for 10 consecutive years. The effects of burning are described above. Since fire is a natural part of this landscape and these burns would be very low intensity, the visual effects would be minimal. In addition, this activity would diversify the vegetative mosaic in regards to vegetative forms, natural appearing lines, and additional colors and textures in the forest stands.

CUMULATIVE EFFECTS

Ongoing and reasonably foreseeable activities that would occur within the analysis area are listed in Appendix B. When considered with the recent Rim Recovery project, portions of the vegetative mosaic across the landscape within the project area would be in a state of transition from salvage logging, hazard tree removal and restoration activities over the next decade. Since there are no regulations for scenic resource management on private lands, the effects of ongoing private development adjacent to Forest lands can sometimes have negative effects on scenic resources of the continuous landscape. When activities on private land are designed to limit impacts to scenic resources, the differences between private lands and Forest lands are less noticeable. The private timber industry lands that were salvage logged, deep tilled, sprayed and planted immediately after the Rim Fire are noticeably distinct from NFS lands and should return to a forested condition far sooner. Currently, they are a very open landscape.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

Anticipated trends include rapid re-growth of the shrub vegetative component and minimal natural regeneration of conifers. The landscape within the Rim Fire perimeter would be dominated by a mix of shrub species. Brush is beginning to dominate some sites which inhibits conifer survival and growth. The scenic attractiveness component of the landscape character may change if the vegetative composition would be dominated by shrub species. A landscape dominated by the shrub component would be outside of the historical range of variation for vegetation. It may take decades to meet the desired landscape character and visual quality objectives for the project area under this alternative. The scenic attractiveness component of the landscape character may change if the vegetative composition is dominated by shrub species. In addition, visual resource improvements would not be implemented to restore facilities, lands, and resources to the Forest Plan VQOs.

CUMULATIVE EFFECTS

Ongoing and reasonably foreseeable activities that would occur within the analysis area are listed in Appendix B. When considered with the recent Rim Recovery project, portions of the vegetative mosaic across the landscape within the project area would be in a state of transition from salvage logging, hazard tree removal and the restoration activities over the next decade. Without reforestation, the vegetation that colonizes the fire area could cause long-term changes in how visitors distribute themselves across the landscape and change the way people experience the scenic values on NFS lands. The private timber industry land planted immediately after the Rim Fire is noticeably distinct from NFS lands and would continue to be so in the long-term. Currently, they are a very open landscape, but in the long-term would provide some forest structure to the north end of the project area.

Alternative 3

DIRECT AND INDIRECT EFFECTS

Similar to Alternative 1, with the differences described as follows.

Plantations

Fuelbreaks are 250 feet wide with one row of 4-tree micro-clusters spaced 26 feet apart within a 90-foot wide strip across the top of the ridge, bordered by 80 feet of trees planted at 15 by 15-foot spacing. The linear edges of the 90-foot fuelbreak would appear un-natural as the trees matured starting between 7 to 10 years when the trees would be at least 5 feet tall. Around half of the trees planted are expected to have survived within 5 years of planting. As the number of live trees decline, the linear features of the fuelbreak would become less apparent including the linear feature of the micro-clumps down the center of the fuelbreak. The 90-foot wide middle area composed of brush would remain intact with few trees for decades. The fuelbreaks could be easily noticed in all distance zones for 7 to 10 years when the trees would be at least 5 feet tall. The fuelbreaks would be more dominant in foreground and middle ground views of developed recreation sites and popular roads and trails. In middle ground and background views the fuelbreak treatments could dominate the landscape for decades if the fuelbreaks are maintained. If so, this could potentially meet the modification VQO in the long-term. “To meet visual quality objectives successfully, fuelbreak design must subdue unnatural contrasts and borrow from natural form, line, color and texture” (USDA 1985). Alternative 3 fuelbreak patterns would appear less natural than those under Alternative 1.

Reforestation

In areas with deep tilling, forest cultivation and hand grubbing release treatments, about 50% seedling survival is expected after 5 years. As the amount of surviving seedlings decreases and more brush moves into the landscape the short-term effect would be a more diverse appearance.

Release consists of hand grubbing on about 21,300 acres to remove the vegetation in a 5-foot radius circle around each seedling. This activity would be done up to two times each year, likely in early spring and late spring to ensure competing vegetation is set back enough to support seedling survival. This would result in a lower survival rate of the planted trees across the landscape. The variable density planting pattern of the plantations would be less evident in the landscape over time when viewed from the middleground than in Alternative 1 since fewer trees would survive. Grubbing would be the most noticeable activity in foreground and middleground views until the trees are 7 to 10 years old due to the soil contrast with vegetation. Grasses and shrubs would cover these areas treated for release within 1 to 2 growing seasons.

In the reforestation areas planting would be done with single trees and clumps of trees of various sizes with variable densities depending upon clump size. The variable density planting pattern would create naturally appearing stands with forms and lines that would blend into the landscape. As the stands mature and reach 20 years or older they would appear natural to forest visitors in all distance zones. The increased mortality would decrease the geometry of the planting patterns in the deer habitat enhancement areas.

Cumulative Effects

Same as Alternative 1.

Alternative 4

Direct and Indirect Effects

Similar to Alternative 1, regarding potential effects to visual resources from proposed activities such as mastication and prescribed fire, with the differences described as follows.

Plantations

In the short-term, Alternative 4 only reforests 20% of the proposed planting areas in the other action alternatives. The limited amount of planting would result in about four times as much of the landscape within the Rim Fire to be dominated by early seral structure including shrubs. This landscape composition would be outside the historic vegetation range of variability and therefore would not appear natural. This departure from historical range of variation may not be noticeable by Forest visitors. Implementing the founder stand planting design across a small portion of landscape would result in natural appearing landscape characteristics. However, the majority of the landscape would be outside of the historic vegetation range of variability.

Prescribed Fire

The additional areas treated with prescribed fire and the use of a tractor line around founder stands to protect them during burning would be noticeable in all distance zones until the end of the first growing season after the fire lines are created. Because the amount of burning is thousands of acres more under this alternative, 34,000 acres every 20 years, the indirect effects to visitors would last far longer than under the other action alternatives.

CUMULATIVE EFFECTS

Same as Alternative 1.

Alternative 5

DIRECT AND INDIRECT EFFECTS

Alternative 5 includes planting the most conifer seedlings of all action alternatives in a consistent pattern, 7 by 14 feet apart, across each unit and within all topographic areas. Long-term effects would result in the most contiguous forested canopy. However, new plantations would be thinned at age 7 to create a more natural appearing stand (ICO structure) as viewed in all distance zones. All fuelbreaks and primary ridges within SFMAs would be planted the same as the rest of the landscape, but thinned at about age 7 to create the desired fuelbreak structure resulting in ridge tops that appear more natural than those described in the other action alternatives.

CUMULATIVE EFFECTS

Same as Alternative 1.

Summary of Effects Analysis across All Alternatives

VQOs Achieved Indicator

The proposed treatments and activities under Alternatives 1, 3, 4 and 5 that would restore the vegetative mosaic within the Rim Fire area are compatible with the Rehabilitation VQO. In the long-term the Retention, Partial Retention and Modification VQOs could be achieved. Under Alternative 2 (No Action), the scenic attractiveness component of the landscape character may change if the vegetative composition were dominated by shrub species which would be outside of the historical range of variation for vegetation in this area. It may take decades to meet the desired landscape character and VQOs under Alternative 2.

Degree of Natural Appearance Indicator

The degree of natural appearance of the management activities varies by alternative:

- **Alternative 1** would eventually appear natural meeting the forest plan VQOs in the long-term.
- **Alternative 2** would not appear natural in the long-term since a shrub dominated landscape would be outside the historical range of variation for vegetation landscape characteristics
- **Alternative 3** would result in more natural appearing landscape characteristics than Alternative 1 due to the variable density planting pattern. As the stands mature and reach 20 years or older they would appear natural to forest visitors in all distance zones. Alternative 3 SFMA fuelbreak design would make ridge tops with fuelbreaks appear less natural than in the other action alternatives.
- **Alternative 4** would result in natural appearing plantations within the founder stands. However, the majority of the landscape falls outside of the regeneration areas and would not appear natural in the long-term since a shrub dominated landscape would be outside the historic range of variation for vegetation.
- **Alternative 5** would plant the most conifer seedlings of all action alternatives. Ridge tops would be planted without consideration for fuelbreaks resulting in more natural appearing landscapes than the other action alternatives. New plantations would be thinned at year 7 creating a more natural appearing stand viewed from all distance zones. Thinning for fuelbreaks at age 7 would result in ridge tops that appear more open than the surrounding landscape. Long-term effects would result in the most contiguous forested canopy.

3.15 WATERSHED

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

Protection of water quantity and quality is an important part of the mission of the Forest Service (USDA 2007a). Management activities on NFS lands must be planned and implemented to protect the hydrologic functions of forest watersheds, including the volume, timing, and quality of streamflow. The following direction is relevant to the action alternatives as they affect water resources.

The Clean Water Act of 1948 (as amended in 1972 and 1987) establishes as federal policy for the control of point and non-point pollution, and assigns the states the primary responsibility for control of water pollution. Compliance with the Clean Water Act by National Forests in California is achieved under state law (below).

Non-point source pollution on national forests is managed through the Regional Water Quality Management Handbook (USDA 2011b), which relies on implementation of 35 prescribed regional Best Management Practices (BMPs), as well as 23 national BMPs (USDA 2012) relevant to this project. Appendix B in the Watershed Report lists these BMPs and their associated management requirements. The project record includes an Erosion Control Plan as required by Regional BMP 2.13 for projects with ground-disturbing activities.

The California Water Code consists of a comprehensive body of law that incorporates all state laws related to water, including water rights, water developments, and water quality. The laws related to water quality (sections 13000 to 13485) apply to waters on the national forests and are directed at protecting the beneficial uses of water. Of particular relevance for the Proposed Action is section 13369, which deals with non-point-source pollution and best management practices.

The Porter-Cologne Water-Quality Act, as amended in 2006, is included in the California Water Code. This act provides for the protection of water quality by the state Water Resources Control Board and the regional water quality control boards, which are authorized by the U.S. Environmental Protection Agency to enforce the Clean Water Act in California.

EO 11988 Floodplain Management (1977) and 11990 Protection of Wetlands direct federal agencies to avoid to the extent possible the impacts associated with the destruction or modification of floodplains and wetlands.

A Conditional Waiver of Waste Discharge Requirements for Discharges Relating to Timber Harvest Activities is issued to the Forest Service by the Central Valley Regional Water Quality Control Board (Water Board). These waivers are required for all timber harvest activities that will or will likely discharge waste that could affect the quality of the waters of the State.

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Effects Analysis Methodology

The five project alternatives were analyzed at three watershed scales to determine direct, indirect and cumulative watershed effects of the Rim Reforestation project. These included large scale watersheds (40,000 to 250,000 acres) and two nesting smaller scales: 10,000 to 40,000 acres and 2,000 to 10,000 acres.

Beneficial uses of water and water quality objectives in the California Water Quality Control Plan (Basin Plan) of the Water Board (CVRWQCB 2011) were utilized as a regulatory benchmark regarding the existing condition and to assess the effects of the proposed action and its alternatives on water quality. The water quality parameters considered in the watershed analysis were water temperature, sediment related parameters, and herbicides. These are the pollutants with the potential of being affected by project management activities.

Assumptions Specific to Watershed

- Watershed condition from the Rim Fire will recover, as will effects of the Rim Reforestation project.
- Water quality effects will occur at a magnitude below adversely affecting beneficial uses of water unless uncontrollable events occur. These include an abnormally high amount and/or intensity of precipitation or the occurrence of another fire in the project area as the watersheds recover from the effects of the Rim Fire.
- Water Quality BMPs will be implemented and effective unless uncontrollable factors occur. These include an abnormally high amount and/or intensity of precipitation or the occurrence of another fire in the project area as the watersheds recover from the effects of the Rim Fire.
- Appendix A in the Watershed Report provides assumptions associated with Equivalent Roaded Acres (ERA) modeling for cumulative watershed effects.

Data Sources

- Satellite Imagery: Worldview, Landsat, and Light Detection and Ranging (LiDAR)
- Forest Land Management Databases and planning documents: Forest Service Activity Tracking System (FACTS) and the Schedule of Proposed Actions (SOPA)
- Stanislaus StreamScape Inventory (SSI): Stream Survey Data from 2005-2012
- Benthic Macroinvertebrate Inventory, Clavey River Ecosystem Project (CREP 2008)
- Burned Area Emergency Response Program: Past Fire information; Rim Fire watershed data
- Geographic Information Systems (GIS)
- Stanislaus National Forest Wild and Scenic River Study (1991)
- Tuolumne River Wild and Scenic Management Plan 1988 (reprint 2002)
- CalFire: Timber Harvest Plans (THPs), Non-Industrial Timber Management Plans (NTMPs) and Notices of Emergency Timber Operations (Frese 2013-2014)
- Yosemite National Park: GIS shapefile with past and future activities within Park boundaries

Watershed Indicators

- Water Quality Parameters: temperature, sediment, herbicides (measure: meet water quality objectives)
- Stream Condition: channel form, streambank stability, pool sediment (measure: SSI protocol)
- Riparian Vegetation: recovery (measures: no damage from project activities; recruitment unimpeded)
- Ground Cover: riparian areas (measures: retention of existing; addition in riparian areas and watershed sensitive areas (WSA) (acres))
- Cumulative watershed effects (measure: ERA)

Watershed Methodology by Action

The direct, indirect and cumulative effects of the five project alternatives were evaluated using the following methods.

DIRECT AND INDIRECT EFFECTS

- Literature Review: a thorough review of the literature was conducted related to the direct and indirect effects of actions that affect the watershed resource as proposed in this project.
- Modeling: a Human Health and Ecological Risk Assessments (SERA, multiple references) was conducted to predict effects of project herbicides on water quality.

- Monitoring: a review of Water Quality BMP Evaluation Program (BMPEP) results on the Stanislaus for activities related to the project was conducted. BMPEP monitoring results over the past decade were useful for predicting outcomes of the management activities proposed in this project. In addition, a review of past herbicide monitoring results on the Stanislaus National Forest was conducted to help inform expected effects of herbicides on water quality related to this project (Watershed Report).
- Field Evaluation: field review of proposed treatment units and watershed conditions within the project area was conducted.
- GIS: used for analyzing data collected from fieldwork, satellite imagery products and forest databases related to the project.

CUMULATIVE WATERSHED EFFECTS

A Cumulative Watershed Effects analysis was conducted using the CWE model adopted by the Pacific Southwest Region of the Forest Service as a method of addressing cumulative watershed effects (USDA 1990). The model is referred to as ERA where values are calculated using a computer model developed on the Stanislaus (Rutten and Grant 2008). Appendix A of the Watershed Report provides further details.

Affected Environment

Watershed Setting

The Rim Fire burned through numerous watersheds in the central and southern portions of the Stanislaus National Forest, and some overlap eastward into Yosemite National Park where the remainder of the fire occurred. These watersheds are an important component of the water supply, fish and wildlife habitat, recreation, timber production and other values of the Sierra Nevada mountain range. Portions of the watersheds within the Rim Fire perimeter burned in several fires during the 20th century, while some areas have not burned in over 100 years. About 98% of the Rim Fire burned within the Tuolumne River watershed. The remaining 2% burned in the North Fork Merced River watershed along the southern edge of the fire.

Watersheds in the Rim Fire are delineated in accordance with the national watershed classification system (USGS 2013). This system is a spatial hierarchy of eight nesting watershed size classes ranging from very large (greater than 250,000 acres) to very small (less than 2,000 acres). This classification system uses the term Hydrologic Unit Code (HUC), as shown in Table 3.15-1, to describe all watershed size classes. They are called HUC levels and are numbered in order from 1 to 8 in descending size class. Each HUC level code is a two digit number that ties to a watershed size and name. For example, HUC Level 1 is a two digit code whereas as HUC Level 5 is a 10 digit code. Table 3.15-1 shows an example of how this nesting system applies to the Rim Fire watersheds.

Table 3.15-1 Hydrologic Unit Code System (HUC)

HUC Level	HUC Name	HUC Size (average acres)	Rim Fire Examples
1	Region	100,000,000	NA
2	Sub-region	10,000,000	NA
3	Basin	7,000,000	San Joaquin River
4	Sub-basin	450,000	Tuolumne River
5	Watershed	40,000 to 250,000	Clavey River
6	Sub-watershed	10,000 to 40-000	Reed Creek
7	Drainage	2,000 to 10,000	Reynolds Creek
8	Sub-drainage	less than 2,000	Lost Creek

The Stanislaus includes HUC Level 4 through 8 watersheds. (The term watershed is often used generically even though each HUC level has a unique name). The HUC Level 4 watersheds on the

Forest are the headwaters of large rivers that continue downstream off the Forest (e.g., Tuolumne River).

Nine HUC 5 Level watersheds are within the Rim Fire; within those, are 18 HUC Level 6 watersheds. Table 3.15-2 displays the HUC Level 5 and HUC Level 6 watersheds relevant to the fire area, including total HUC Level 5 and HUC Level 6 watershed acreage. Note that the HUC Level 6 watershed acreage does not add up to that of 7 of the 9 HUC Level 5 watersheds. This is because in those watersheds additional HUC Level 6 watersheds are fully outside the fire perimeter. Watershed acreage within the Stanislaus boundary is less in some watersheds and will be described in the existing condition and environmental consequences sections of this report. The HUC Level 5 watersheds in Table 3.15-2 are listed clockwise around the fire area beginning where the main channel of the Tuolumne River exits the Rim Fire perimeter.

Table 3.15-2 Rim Fire Area Principal Watersheds and Condition Overview

HUC Level and Name	Size (acres)	In RIM (%)	In NF (%)	SBS HIGH	SBS MOD	SBS LOW
5. Big Creek-Tuolumne River	81,721	56	70	5	27	68
6. Big Creek	18,734	1	52	0	1	99
6. Grapevine Creek-Tuolumne River	23,817	77	82	1	26	73
6. Jawbone Creek-Tuolumne River	27,629	99	100	14	56	30
7. Corral Creek	4,581	100	100	31	58	11
7. Lower Jawbone Creek	5,670	100	100	10	75	15
5. North Fork Tuolumne River	63,849	9	92	0	3	97
6. Lower North Fork Tuolumne River	34,210	17	89	1	6	93
5. Clavey River	100,645	52	100	3	15	82
6. Lower Clavey River	17,871	100	100	4	45	51
7. Bear Springs Creek-Lower Clavey River	7,090	100	100	7	43	50
6. Middle Clavey River	26,912	69	100	2	11	87
6. Reed Creek	24,527	66	100	7	16	77
7. Lower Reed Creek	7,495	100	100	21	41	38
5. Cherry Creek	90,892	24	93	3	12	85
6. Lower Cherry Creek	24,383	84	98	10	43	47
7. Granite Creek	4,126	100	100	30	62	8
6. Upper Cherry Creek	16,344	7	100	0	1	99
6. West Fork Cherry Creek	26,149	1	100	0	1	99
5. Eleanor Creek[1]	59,906	28	2	1	9	90
6. Miguel Creek-Eleanor Creek	15,798	76	6	4	31	65
5. Falls Creek-Tuolumne River[1]	124,244	19	4	1	5	94
6. Poopenaut Valley-Tuolumne River	18,232	99	30	6	33	61
5. Middle Fork Tuolumne River[1]	46,635	68	34	7	32	61
6. Lower Middle Fork Tuolumne River	14,928	100	100	6	57	37
6. Upper Middle Fork Tuolumne River	31,707	53	3	8	21	71
5. South Fork Tuolumne River[1]	57,855	88	41	4	29	67
6. Lower South Fork Tuolumne River	19,988	100	100	4	43	53
6. Upper South Fork Tuolumne River	37,866	83	9	3	22	75
5. North Fork Merced River	79,110	8	81	0	3	97
6. Bull Creek	21,064	6	100	0	2	98
6. Bean Creek-North Fork Merced River	36,739	14	92	0	4	96
Rim Fire Summary[1]			**69**	**7**	**37**	**56**

LOW=Low and Unburned; MOD=Moderate; NF=National Forest; RIM=Rim Fire; SBS=Soil Burn Severity (percent of Fire area)
[1] Substantial portion of the Rim Fire extends east into Yosemite National Park.

Given the large size of the fire, the HUC Level 6 watersheds are the most appropriate scale for watershed description and analysis of the effects of the Rim Reforestation project. HUC Level 5 watersheds will be described for spatial context and broad scale analysis, and selected HUC Level 7 watersheds will be discussed where more detailed analysis is indicated. Figure 3.15-1 displays the HUC Level 6 watersheds relevant to the Rim Fire.

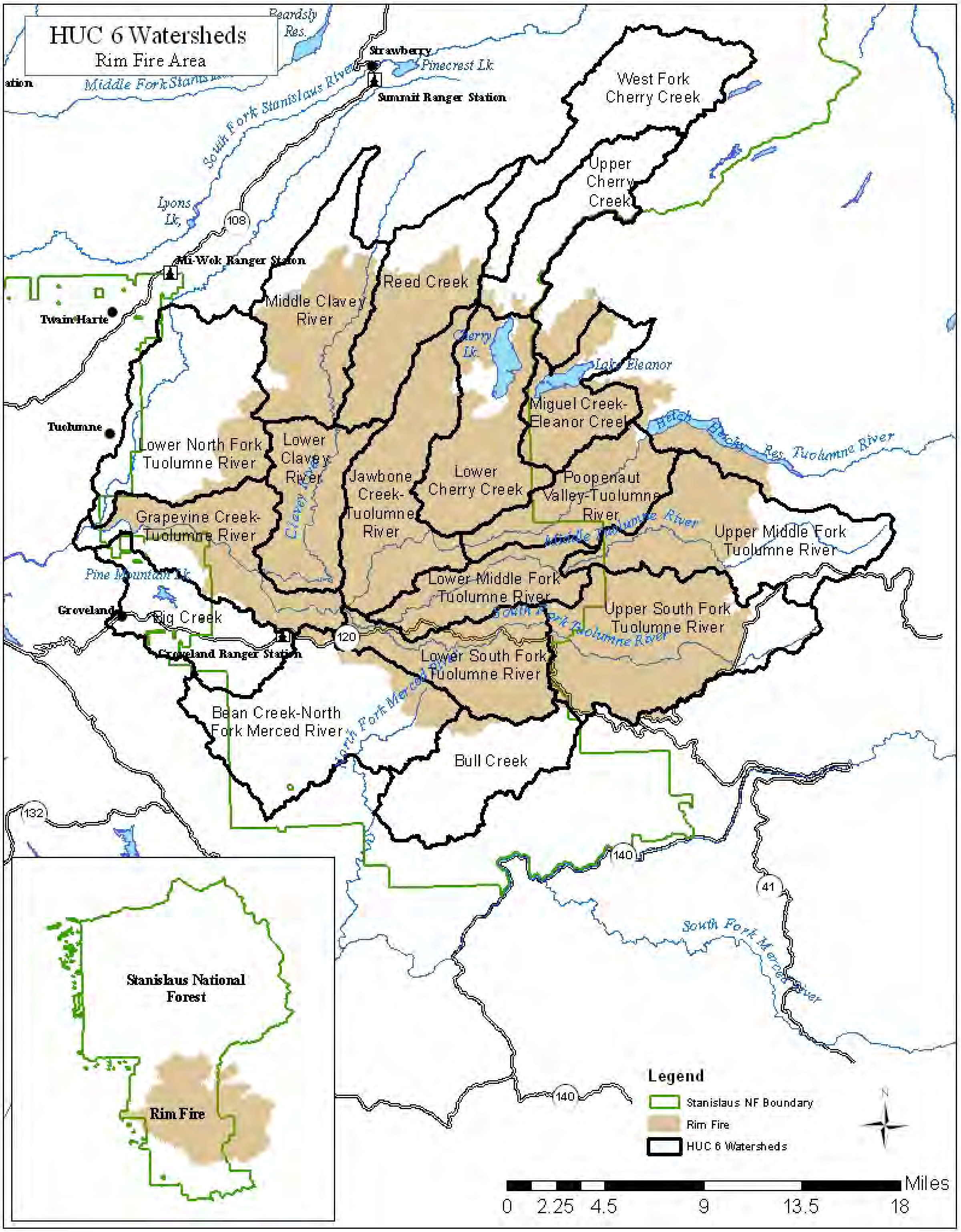

Figure 3.15-1 HUC Level 6 Watersheds in the Rim Fire Area

Existing Conditions

Several factors that affect watershed condition have occurred in the Rim Reforestation project area. These include natural events and management activities that create ground disturbance and alter natural hydrologic processes. The effects of the Rim Fire have a strong influence on existing conditions, and will be discussed further below. The Rim HT and Rim Recovery projects, which began the Rim Fire restoration process, are the most recent projects within the analysis area. Rim HT is essentially completed and Rim Recovery is about 70% complete and implementation will continue regardless of the decision that is made for the Rim Reforestation project. This watershed analysis considers the effects of the initial two projects as part of the existing condition in the cumulative effects analysis (Appendix B).

WILDFIRE EFFECTS

The Rim Fire, like almost all wildfires, is a mosaic of high, moderate and low soil burn severity plus unburned areas within its perimeter. Many past fires occurring within the Rim Fire perimeter have nearly half or more of their total acreage in the low and unburned categories that resulted in minimal to negligible watershed impact. Most watershed damage occurs from high soil burn severity, and lesser from moderate soil burn severity.

The principal effects of soil burn severity are the reduction of ground cover and infiltration capacity. High soil burn severity has the most watershed effect since it usually results in very low remaining ground cover, ranging from 0 to 20%, and the most increase in water repellency. These factors make it insufficient to adequately prevent accelerated soil erosion and, where eroded soil can reach waterways, cause stream sedimentation. Moderate soil burn severity is usually less damaging since the soil is not as impacted and the singed conifer needles fall to the forest floor initiating replacement of burned ground cover. Low soil burn severity is usually an insignificant factor since most pre-fire cover remains and infiltration is mostly retained.

High soil burn severity usually chars the soil crust, damaging soil structure, killing plant roots, removing all, or mostly all, ground cover (litter and duff) and often results in strongly water repellent soil. Moderate soil burn severity does less damage since its soil structure effect and degree of water repellency is usually lower. Low soil burn severity has minimal soil impact, usually scorching ground and portions of tree trunks and bases of tree crowns; few trees are killed. The combination of high and moderate soil burn severity usually represents what is known as a stand replacing fire since nearly all trees are killed. Often in forested areas, post-fire vegetation condition acts as a visual indicator of soil burn severity. High soil burn severity is indicated by fully killed trees with all needles and often many branches consumed. Moderate soil burn severity is viewed as killed trees with browned needles remaining (most fall before winter, providing natural ground cover). Low soil burn severity usually results in patchy ground fire with lower portions of trunks blackened and some lower crowns singed.

Soil burn severity is a measure of the effect of ground heat as a fire burns across a landscape, and is not the same as fire intensity or vegetation burn severity. Fire intensity is a measure of heat produced by a fire (BTUs). Vegetation burn severity measures both vegetation canopy mortality and vegetation basal area mortality resulting from wildfire. For the remainder of this report reference to burn severity will mean soil burn severity unless otherwise noted.

While the Rim Fire area is the largest of the fires within the forest to date, it does not have the highest soil burn severity. Its high soil burn severity is the second lowest of the principal fires within its perimeter since 1973. Though its high soil burn severity is much less than its next largest predecessor, the Stanislaus Complex Fire of 1987, the Rim Fire has resulted in about 10,000 acres of very low ground cover distributed in various sized large to small patches across the 154,530 acres of NFS land it burned. Table 3.15-3 displays soil burn severity for the six largest fires within the Rim Fire perimeter that have soil burn severity information.

Table 3.15-3 Soil Burn Severity for Selected Fires in Relation to the Rim Fire

Fire	Year	NFS (acres)	SBS HIGH	SBS MOD	SBS LOW	Notes
Rim	2013	154,530	7	37	56	
Stanislaus Complex	1987	147,100	36	20	44	
Rogge	1996	19,400	0	41	59	No high soil burn severity due to low fuel loading over much of the area because of new plantations after the Stanislaus Complex fire.
Granite	1973	17,100	55	30	15	
Ackerson	1996	11,300	19	14	67	This fire was much larger overall with most acreage in Yosemite National Park.
Pilot	1999	4,000	46	25	29	

LOW=Low and Unburned; MOD=Moderate; SBS=Soil Burn Severity (percent of Fire area)

Distribution of soil burn severity within a fire area is also important. A spatial mosaic of all severities can reduce on and off-site soil and water effects while concentrations of high soil burn severity can cumulatively increase effects. The largest concentrations of high soil burn severity in the Rim Fire occurred in Granite Creek, within the 1973 Granite Fire, and in the Corral Creek and Reed Creek areas, both believed unburned in about 100 years. Other lesser high soil burn severity concentrations are scattered throughout the fire area, surrounded by moderate and/or low soil burn severity areas as well as unburned areas.

These concentration areas, and other smaller severely burned sites in the fire, were identified by the Rim Fire BAER team as a watershed value at risk for loss of soil productivity and delivery of stream sedimentation. As a result, action to minimize the risk was taken in November, 2013. Helicopters applied weed free rice straw mulch to 4,300 acres of the highest priority portions of these locations (i.e., steep slopes, high erosion risk, and stream proximity). Helicopter mulching produces a uniform layer of straw, about 1 to 1.5 inches deep that provides 80 to 100% ground cover. An additional BAER action, mastication, was conducted on 40 acres of high soil burn severity area to increase ground cover. Mastication is mechanical chipping of small trees. Low-ground-pressure tracked equipment with an articulated arm and a chipping head provides immediate cover to bare areas.

The Tuolumne River canyon is another burn concentration area in the Rim Fire. The fire began near the Clavey River confluence, continued upstream to Cherry Creek, then up Cherry Creek to Eleanor Creek in Yosemite National Park. Much of the canyon vegetation is dominated by chaparral and other flashy fuels which burned hot and fast up canyon, where the fire then spread northward and led to the conifer dominated high soil burn severity concentrations mentioned above. The canyon soil burn severity is classed as moderate, even though vegetation was well consumed, since the fire here had little residence time and thus, minimally degraded soil properties or increased watershed runoff response. This concentration area is a near repeat of the 1987 Stanislaus Complex Fire. The Tuolumne River canyon burns easily, and the mature 26-year-old vegetation was ready to burn again.

Overall in the Rim Fire, effective watershed cover exists on about 56% of the land within the fire perimeter (the total of the low soil burn severity and the unburned portion within the fire perimeter). This cover consists of living vegetation which primarily includes conifer trees with forest floor litter and duff, plus brush and smaller woody shrubs. This ground cover has been supplemented in much of the moderately burned conifer areas due to needle cast. While this is not as effective as living cover it does provide a measure of effectiveness compared to high burn severity areas since it resists initiation of rainsplash erosion. Helicopter mulching and mastication mitigated some of the worst high soil burn severity areas, but other locations of high soil burn severity areas remained with inadequate cover soon after the fire. However, it is worth to note that natural recovery of live vegetation has been happening at a fast pace throughout the project area.

In summary, the Rim Fire was a mixed severity fire, not only across the entire fire, but at all watershed scales. Patch size of each soil burn severity class in this mosaic was also mixed with some patches hundreds to several hundreds of acres, others tens to hundreds, and yet others where all three classes occurred within ten acres. Mixed severity was also distributed similarly from stream to ridge within most watersheds. Riparian areas burned in a mosaic as did the hillslopes above them. The largest high soil burn severity patches occurred in the uplands, mostly on south-facing slopes where the fire could easily pre-heat fuels.

At the Rim Fire scale, the amount of soil burn severity varies widely among and within all HUC level watersheds. In general it is least for the HUC 5 watersheds, more for the HUC 6 watersheds and greatest for the HUC 7 watersheds. Many HUC 5 watersheds, being the largest, have substantial portions outside the Rim Fire perimeter. The HUC 6 watersheds, though generally having more acreage within the fire, also have a highly variable amount of soil burn severity based on fire location and watershed acreage within the fire perimeter. The HUC 7 watersheds, that have the highest burn severity, have been selected as watershed analysis emphasis areas due to severe burn and/or concentrated post-fire management activities.

Table 3.15-2 provides an overview of the three watershed scales and the portion each occupies within the Rim Fire and the Stanislaus. It also shows the soil burn severity of each watershed as an indicator of existing condition relative to ground cover and vegetation alteration by the fire. Rim Fire information is provided at the top of the table for comparison with the HUC Level 5, 6, and 7 watersheds. Refer to Figure 3.15-1 for the locations of the HUC 6 watersheds as well as to gain an understanding of the locations of their HUC 5 and 7 counterparts.

Table 3.15-2 shows the similarities and variations among watersheds. Watershed area within the fire perimeter ranges from 1 to 100% among the HUC 5 and 6 watersheds, and all the HUC 7 watersheds are 100% within the perimeter. The percentage of watershed area within the Stanislaus is high for all watersheds except for portions of the 4 HUC 5 watersheds that extend east of the Forest into Yosemite National Park.

The amount of soil burn severity across the fire also exhibits similarities and variations by watershed. Moderate soil burn severity is greater than high severity in every watershed, ranging from2 to 10 times as much. High soil burn severity is similar in almost all HUC 5 and HUC 6 watersheds; all 9 HUC 5s are less than 10% as are 16 of the 18 HUC 6s. HUC 7 watersheds are dissimilar to their larger counterparts in that they almost all have greater high and moderate soil burn severity.

Table 3.15-2 also shows that 25 of the 32 watersheds have more than 50% acreage in the low soil burn severity and unburned class. Half of those watersheds have greater than 75% in this same class. The remaining 7 watersheds include all 5 HUC 7s and 2 of the more heavily burned HUC 6s: Lower Cherry Creek and the Lower Middle Fork of the Tuolumne River. The fire wide average of 56% in the low and unburned class is made up of a high percentage of predominantly low and unburned watersheds punctuated by several highly burned ones.

The most visible watershed impact of the fire was in the high soil burn severity areas since it reduced ground cover to less than 20%, often near zero. Ground cover in the moderate soil burn severity areas was also substantially reduced as nearly all trees were killed by the fire, though needle cast replacement cover of 50% or more occurred in many of the conifer forested areas before winter. However, a vegetation monitoring was conducted this field season 2015 by Forest Service personnel on units proposed for reforestation (approximately 26,009 acres, including deer and natural regeneration units). Within the Composite Burn Index (CBI) of high, moderate, low, and unchanged severity areas, vegetation cover averaged 61%, 50%, 23% and 4%, respectively. Overall cover of shrubs, grasses, and forbs have a positive correlation with burn severity, increasing on average from 4% cover in unchanged areas to greater than 60% cover in high-severity burn areas. Vegetation (Chapter 3.13) provides additional information on post-fire vegetation monitoring.

VEGETATION CONDITION

Hillslopes

The remaining live vegetation within the Rim Fire perimeter consists largely of second growth forest stands from legacy logging as well as more recent various aged timber plantations. It also consists of unlogged natural stands, some of which are very old. Despite the diversity of this vegetation, it almost all currently shares a common trait: high stand density. An excessive number of tree stems per acre creates closed canopies and an undesirable fuel ladder. This dense condition leaves unburned forest vegetation elsewhere as vulnerable to future high severity wildfires as has recently occurred. At the scale of the Rim Fire about 44% of live vegetative canopy was lost, in various mosaic patterns, and about 56% remained largely unaffected. As Table 3.15-2 showed, the amount of soil burn severity and vegetation burn severity varied substantially among the watersheds in the fire area.

Riparian Conservation Areas

Riparian Conservation Areas (RCAs) are corridors along stream channels and surrounding meadows, springs and other wetland areas that provide habitat for plants that thrive on a high water table. These riparian obligate species include resprouting trees such as alders, big leaf maples, dogwoods, cottonwoods and aspens, shrubs such as willows, and a variety of streamside and meadow herbaceous plants. Conifers also coexist in RCAs with obligate species, often growing well near streams.

Table 3.15-4 shows the watershed effect of the Rim Fire on vegetation condition in RCAs by watershed. A 100-foot zone along all perennial and intermittent streams (100 feet on each side for a total width of 200 feet) was selected to focus on the immediate near-stream complex of obligate and non-obligate vegetation in the cooler, moister microclimate along streams, often referred to as the “riparian bubble.” These RCAs often includes the immediate channel and its flood prone areas and or adjacent terrace. The upslope remainder of the 300 or 150-foot RCA widths are usually dominated by hillslope vegetation and warmer air temperatures. Both soil and vegetation burn severity measures were assessed for validation of comparability. This 100-foot buffer represents an average of about 7% of the total area in the Rim Fire watersheds, with a range of 5 to 9% among all watersheds.

The RCA columns in Table 3.15-4, display soil and vegetation burn severity for all HUC 6 and HUC 7 watersheds in the Rim Fire. The RCA H + M column is the sum of high and moderate soil burn severity in the 100-foot stream buffer. The Watershed column displays the sum of the high and moderate burn severity for the entire watershed. The RCA H + M column is the key information for comparing soil to vegetation burn severity and RCA-to-watershed soil burn severity.

Table 3.15-4 shows that RCA soil and vegetation burn severity match closely in almost all watersheds. In 21 of 23 watersheds soil and vegetation burn severity are within 5% of one another, and the remaining two are 7% and 8%. In most cases the vegetation burn severity is equal to or slightly less than the soil burn severity. The two measures validate they are comparable for estimating vegetation loss. Soil burn severity has the added advantage of also being able to indicate ground cover condition.

Comparing RCA to watershed, Table 3.15-4 shows that RCA soil burn severity is in most cases less than for the watershed as a whole. RCA soil burn severity is not higher than watershed soil burn severity in 19 of the 23 watersheds in Table 3.15-4. The 4 that are higher are barely so, and many of the watershed soil burn severity percentages are much higher than the RCA.

The Rim Fire burned less severely near the streams than in the uplands in almost all watersheds, and substantially less in many. And though it burned less in RCA there was still a notable loss of the stream shade capacity of conifers and riparian obligate trees and shrubs in many watersheds. But while the conifers will be long in returning to replace shade, the riparian trees will fill the void in the short run and also provide biodiversity along stream reaches burned in the Rim Fire.

Table 3.15-4 Riparian Conservation Area Soil and Vegetation Burn Severity

HUC Level and Name	% RCA SBS HIGH	% RCA SBS MOD	% RCA SBS LOW	% RCA SBS H+M	% RCA VBS HIGH	% WAT SBS H+M
5. Big Creek-Tuolumne River						
6. Big Creek	0	0	100	0	0	0
6. Grapevine Creek-Tuolumne River	0	11	89	11	15	27
6. Jawbone Creek-Tuolumne River	11	38	51	49	50	70
7. Corral Creek	41	51	9	92	88	89
7. Lower Jawbone Creek	3	42	55	45	49	85
5. North Fork Tuolumne River						
6. Lower North Fork Tuolumne River	1	8	91	9	6	7
5. Clavey River						
6. Lower Clavey River	1	19	80	20	19	49
7. Bear Springs Creek-Lower Clavey River	2	17	81	19	14	50
6. Middle Clavey River	1	7	92	8	7	13
6. Reed Creek	3	10	87	13	11	23
7. Lower Reed Creek	12	31	56	43	41	62
5. Cherry Creek						
6. Lower Cherry Creek	13	34	53	47	45	53
7. Granite Creek	35	59	6	94	91	92
6. Upper Cherry Creek	0	0	100	0	0	1
6. West Fork Cherry Creek	0	0	100	0	0	0
5. Eleanor Creek[1]						
6. Miguel Creek-Eleanor Creek	4	34	62	38	41	35
5. Falls Creek-Tuolumne River[1]						
6. Poopenaut Valley-Tuolumne River	5	27	68	32	32	39
5. Middle Fork Tuolumne River[1]						
6. Lower Middle Fork Tuolumne River	5	50	45	55	50	63
6. Upper Middle Fork Tuolumne River	3	22	75	25	17	29
5. South Fork Tuolumne River[1]						
6. Lower South Fork Tuolumne River	2	23	75	25	18	46
6. Upper South Fork Tuolumne River	4	19	77	22	17	25
5. North Fork Merced River						
6. Bull Creek	0	2	98	2	2	2
6. Bean Creek-North Fork Merced River	0	2	98	2	2	4

H+M=High plus Moderate; LOW=Low and Unburned; MOD=Moderate; SBS=Soil Burn Severity (percent of Fire area); VBS HIGH=Vegetation Burn Severity High (Canopy Mortality 75 to 100%); WAT=Watershed (total acres)
[1] Substantial portion of the Rim Fire extends east into Yosemite National Park.

TRANSPORTATION SYSTEM CONDITION

Road density in the Rim Fire area ranges from 1 to 6 miles of road per square mile, with an average of about 4 miles per square mile. This is similar to other roaded multiple-use areas within the forest. Prior to the Rim Fire, the existing road network within its perimeter was adequate to serve the needs of forest management activities. As part of the post-fire salvage harvest, minimal road construction had a negligible change in road density.

Road sediment discharge increases are expected as a result of the Rim Fire. Most increases are likely to occur in high soil burn severity areas within the Rim Fire, and to a lesser extent in moderate soil burn severity areas. Problems include locations of improper road drainage function and culverts at road-stream crossings. The undersized culverts cannot handle post-fire flow volume and the additional woody debris and sediment it carries. The quantity and effect of fire-related sediment-delivery increase is uncertain, due to variability in winter weather prior to the implementation of the Rim Reforestation. Forest roads cause hydrological effects by concentrating and channelizing surface and subsurface flow. Following wildfire, the ability of the landscape to filter runoff from roads can be reduced due to a decrease in ground cover (Peterson et al. 2009).

STREAM CONDITION

Stream condition inventories were conducted along portions of 23 streams within the Rim Fire area between 2005 and 2012. These are part of the forestwide Stanislaus StreamScape Inventory (SSI) program to determine stream condition prior to management activities or for baseline watershed information (Frazier et al. 2008). SSI consists of 21 attributes of stream condition measured continuously along wadeable stream channels in lengths that have ranged from about 1 to nearly 10 miles. Some larger streams become wadeable by late summer, such as the Middle and South Forks of the Tuolumne River, the Clavey River and Reed Creek. They, among many of their tributaries, comprise the streams represented here. The main channel of the Tuolumne River has not been inventoried due to its size and regulated flow regime which create unsafe SSI working conditions. Table 3.15-5 summarizes the existing condition of these streams based on key indicators.

Table 3.15-5 Rim Fire Stream Condition Summary for Stream Channel and Stream Habitat Indicators

Indicator	Measure	Streams	Conditions
Stream Channel	Streambank Stability	21	over 75%
Stream Channel	Streambank Stability	1	50 to 75%
Stream Channel	Streambank Stability	1	less than 50%
Stream Channel	Channel Form	16	over 75% normal or rejuvenating
Stream Channel	Channel Form	4	50 to 75% normal or rejuvenating
Stream Channel	Channel Form	3	less than 50% normal or rejuvenating
Stream Habitat	Pool Tail Fine Sediment	16	less than 10%
Stream Habitat	Pool Tail Fine Sediment	3	10 to 20%
Stream Habitat	Pool Tail Fine Sediment	4	over 20%
Stream Habitat	Pool Bed Fine Sediment	18	less than 10%
Stream Habitat	Pool Bed Fine Sediment	3	10 to 20%
Stream Habitat	Pool Bed Fine Sediment	2	over 20%
Stream Habitat	Water Temperature Maximum	10	less than 59 degrees F
Stream Habitat	Water Temperature Maximum	9	59 to 68 degrees F
Stream Habitat	Water Temperature Maximum	4	over 68 degrees F

Stream Channels

Streambank stability is assessed in quartile percentage classes at 328-foot (100-meter) increments. The summary above represents the percentage of streambank stability on all streams inventoried. Twenty-one of the 23 streams have a majority of their stream length in the greater than 75% stability quartile with no 328-foot increments less than 50% stable. This indicates the streambank stability for the surveyed stream is either fully or highly likely to be greater than 75%, which represents a very stable stream system. Numerous streams have over 90% of their length fully classified in the upper quartile.

Channel form, or cross-sectional shape, is assessed in SSI in four classes which depict excellent to poor condition. The Normal class is one whose channel fits proper morphological features for its stream type. These factors include width-to-depth and entrenchment ratios, streambank angle, and other measures of channel shape (Rosgen 1996). The Rejuvenating class is a channel form that shows evidence of legacy disturbance but is recovering or has recovered to good condition. These classes are combined to assess condition of the channel form. For example, a stream with more than 75% of its length in these classes, provided the Normal class is greater, is in very good condition. Sixteen of the inventoried streams are in this condition, while the remaining streams have some portions with evidence of accelerated incision or widening.

Overall, the two stream channel indicators show a high percentage of the inventoried streams were in very good condition prior to the Rim Fire. Stream condition is expected to be affected by post-fire erosion and sedimentation though the magnitude is uncertain, and is largely reliant upon winter weather events. Effects may be mitigated in areas that received BAER hillslope and road treatments in the fall of 2013 as well as in areas where effective and adequate natural re-growth has taken place to a level that can minimize surface erosion and sedimentation.

Stream Habitat

SSI quantitatively measures stream pool sediment serving as indicators of stream habitat quality and sedimentation. Pools are the sediment reservoirs in streams. Sediment in stream pools is an indicator of erosion from the upstream watershed, and thus shows whether excessive input is present. Excessive sedimentation can arise from ground disturbing management activities such as timber harvest or roads, or from fires, floods or mass wasting (e.g., landslides, debris flows). Fine sediment is measured since it represents the smallest soil particles, which are the key components of aquatic habitat. Excessive fine sediment in stream pool tails can reduce fish spawning success. Excess pool bed sediment reduces pool area that can be used for fish rearing and productivity. Pool tail fine sediment is calculated at pool outlets, and pool bed fine sediment is measured throughout the full length of stream pools. Pool tail sediment less than 20% is usually considered suitable for fish spawning. Pool bed sediment, measured as the length of fine sediment deposition in a pool, characterizes the amount of settleable material (material heavy enough to sink to the bottom of a pool) sourced from the watershed. The same percentage threshold is used for pool bed sediment as for pool tails.

As shown in Table 3.15-5, pool tail and pool bed sediment were very low in the inventoried streams. It is not excessive since presence of native fish of all age classes are common or abundant in these streams. The amount of pool sediment in these streams is an indicator of a very stable watershed landscape, including recovery from past disturbances by wildfire and ground-disturbing management activities.

Water temperature was also excellent in these streams. The SSI data in Table 3.15-5 are the maximum daily temperatures and all are suitable for the native aquatic organism communities. Even the streams with maximum temperatures exceeding 68 degrees Fahrenheit, a threshold of concern for cold water fish, were only slightly higher and their minimum daily temperatures are well below the threshold.

Benthic macroinvertebrates (BMI) are another indicator of stream health. They were sampled in the Clavey River in 2007 as well as several of its tributaries within the Rim Fire perimeter as part of the stream condition inventory for the Clavey River Ecosystem Project (CREP 2008). The BMI data were evaluated using the River Invertebrate Prediction and Classification System (RIVPACS) (Hawkins et al. 2000). Numeric values very close to 1 indicate reference condition, meaning streams are in as good of condition as naturally occurs. Numbers exceeding 1 are better than what is expected. A score of 0.9 or 90% means the stream health is in excellent condition. Streams and their BMI scores are as follows: Two Mile Creek (0.991), Hull Creek (1.106), Clavey River (0.927), Reed Creek (1.021), Bourland Creek (1.166), Cottonwood Creek (1.166) and Bear Springs Creek (0.932). No impairment of stream habitat or water quality was evident.

Between the time of collection of the stream condition data and the Rim Fire there were no significant management activity disturbances or natural events that would have been likely to substantially alter stream conditions.

WATER QUALITY CONDITION

Prior to the Rim Fire, water quality within the fire perimeter was considered excellent at all the watershed scales previously described. Throughout the main Tuolumne River and its tributaries there is substantial evidence of high quality water. The EPA maintains a list of waters with impaired water quality under Section 303(d) of the Federal Clean Water Act (CVRWQCB 2010). The Tuolumne River is not listed as an impaired stream, nor is the Merced River. At the smaller scale, SSI and BMI data collected in the Rim Fire area have shown evidence of excellent water quality where sampled in the watersheds across the fire area.

Water quality degradation resulting from erosion and stream sedimentation following the Rim Fire occurred as expected for a winter (2013/2014) that turned out to be only about 50% of average precipitation with few storms exceeding a 1 to 2 year return interval. Early winter rainfall began to mobilize easily dislodged ash and streamside sediment in highly burned areas with little ground cover. Streams and rivers ran variably turbid, some very much so, during and after succeeding storms depending on rainfall intensity, soil type and other factors. Decreases in turbidity and sediment transport occurred between storms. This process of storm driven sediment delivery and transport repeated itself over the low-rainfall winter of 2014/2015. Sediment mobilization, transport and deposition were minor to moderate, without major degradation.

Environmental Consequences

Alternative 1 (Proposed Action)

DIRECT AND INDIRECT EFFECTS

Direct and indirect effects of proposed activities are described below for 13 of 18 HUC 6 watersheds and 5 HUC 7 watersheds. Five HUC 6 watersheds (Big Creek, Upper Cherry Creek, Bull Creek, Bean Creek-North Fork Merced River, and West Fork Cherry Creek) are not assessed below due to the negligible amount of high and moderate soil burn severity (Table 3.15-2) and proposed project activities in their watersheds. Proposed treatments within these watersheds cover a relatively low percentage of the total watershed acres and therefore are too small for consideration in this analysis. Project consequences in these watersheds would be negligible and not likely detectable. The selection of 5 HUC 7 watersheds is described in Appendix A of the Watershed Report: Cumulative Watershed Effects Analysis Methodology.

Erosion and Sedimentation

Soil Compaction

Compaction of soil from mechanized equipment can lead to hydrologic effects such as lower infiltration rates and increased runoff. These effects are anticipated to occur in the portion of the project area where thinning in existing plantations and mechanical site preparation are proposed. The effects would be minimized on those areas where deep tilling and forest cultivation would be combined as a follow-up site preparation activity. Conversely, equipment tracking could break down the hydrophobic layer, providing a positive effect.

Soil Displacement

In existing plantation thinning units, feller-bunchers “bunch” the logs into a pile for the skidder to move. Minor displacement of soil may occur in the feller-buncher tracks, particularly where the equipment has turned.

Management requirements of mechanical impacts (e.g., slope and wet season limitations) are anticipated to minimize or prevent erosion and sedimentation. Mastication, while potentially causing some on-site soil displacement, also provides a mulch cover to mitigate erosion risk.

Ground Cover

Management requirements were designed to maintain or increase ground cover in near-stream areas. Within RCAs, ground cover is expected to increase under the proposed action as a result of maintaining post-fire conifer needle cast, application of ground cover by leaving dead plant material and limbs, or by mastication, along with the natural recovery of live vegetation. A maximum of 20 tons per acre of fuel loading would remain.

BMP monitoring is completed annually on the Stanislaus to assess the effectiveness of BMPs. The Watershed Report describes BMP effectiveness in preventing and minimizing erosion and sedimentation on past projects.

Mechanized Equipment Activities

Effects of site preparation with tractors and thinning existing plantations with feller bunchers on water quality could include increases in sedimentation caused either by the transport of eroded material out of treated areas into stream channels, or by increased flows that result in channel erosion that in turn increases sedimentation. Best Management Practices (BMPs) are applied to minimize erosion and sediment delivery to streams. MacDonald and Stednick (2003) note that fuels treatments should have little effect on water quality if they are well-planned and BMPs are implemented.

Mastication has the potential to disturb or compact soil but has not been widely studied (Robichaud et al. 2010). Hatchett et al. (2006) concluded that erosion and compaction on their study area’s coarse sandy loam were minimal, but that their findings were probably the result of the equipment being operated on masticated material rather than on bare ground. The precipitation simulations in their study did not produce runoff on the plots with masticated material for groundcover. Moghaddas and Stephens (2007a) found that commercial thinning of a mixed conifer forest followed by mastication did not increase compaction of the Holland and Musick series soils in their study area. Based on these studies and previous experience with the treatment on the Stanislaus, mastication is expected to increase soil cover and organic matter and cause slight or minimal decrease in porosity. The treatment leaves good groundcover and does not significantly increase erosion, so increases in runoff or erosion are not expected to occur.

Despite the variability in research results, some key points are brought up repeatedly in the literature including: 1) Minimize compaction to the extent possible; 2) Minimize soil displacement; 3) Maintain or increase ground cover to filter sediment. Management requirements and BMPs were designed to accomplish these three tasks.

Table 3.15-6 Alternative 1: Mechanical Activities by Soil Burn Severity

HUC Level and Name	SBS HIGH	SBS MOD	SBS LOW
6. Grapevine Creek-Tuolumne River	0	26	46
6. Jawbone Creek-Tuolumne River	68	96	94
7. Corral Creek	32	46	7
7. Lower Jawbone Creek	0	0	1
6. Lower North Fork Tuolumne River	0	19	20
6. Lower Clavey River	1	47	30
7. Bear Springs Creek	0	3	1
6. Middle Clavey River	0	6	4
6. Reed Creek	11	12	16
7. Lower Reed Creek	11	10	6
6. Lower Cherry Creek	66	135	44
7. Granite Creek	54	76	2
6. Miguel Creek-Eleanor Creek	0	0	2
6. Poopenaut Valley-Tuolumne River	4	4	0
6. Lower Middle Fork Tuolumne River	16	101	43
6. Upper Middle Fork Tuolumne River	0	6	6
6. Lower South Fork Tuolumne River	5	38	37
6. Upper South Fork Tuolumne River	0	1	3

LOW=Low and Unburned; MOD=Moderate; SBS=Soil Burn Severity (percent of Fire area)

From a hydrologic standpoint, increased compaction, increased soil displacement, and changes in ground cover are most critical in the near stream areas where stream sedimentation is most likely.

Knowledge of soil burn severity in these areas is important because areas of low soil burn severity have much greater potential to filter sediment than areas of high soil burn severity. Table 3.15-6 describes mechanical activities acres (thin/biomass, machine piling, mastication, deep tilling and forest cultivation) within 100 feet of perennial or intermittent streams and special aquatic features (SAFs) by soil burn severity.

Despite implementation of BMPs and management requirements, increased stream sedimentation is anticipated as a result of the proposed action, particularly in areas where mechanical activities create more effective sediment transport networks to stream channels. This is more likely to occur in the Jawbone Creek-Tuolumne River, Corral Creek, Lower Cherry Creek, and Granite Creek watersheds than in other HUC 6 or HUC 7 watersheds due to the larger acreages of near-stream high soil burn severity.

Piling and Burning

Jackpot burning and hand piling and burning would result in reduced fuel loading with very little ground disturbance. Although some soil movement could occur following these activities, it is anticipated to be minor and short-term. Pile burning essentially results in small isolated areas of high-severity burn spots located beneath the piles. High-severity impacts include increased runoff and erosion (MacDonald et al. 2004). The associated effects on runoff and erosion would be mitigated by the small size of the burned patches, the unburned areas between them, and buffers along streams where piles will not be burned to ensure a filter strip between these areas and streams (Chapter 2.03). A recent study (Hubbert et al. 2013) found that burning piles within 23 feet of streams did not affect water quality. Hand cut and pile treatments have not been shown to cause ground disturbance that would lead to erosion and sediment delivery. These treatments are considered to have minimal potential to impact water quality.

Machine piling could be implemented using either a dozer (dozer piling) or an excavator or other similar piece of equipment (grapple piling). Tractors with brush rakes cause more direct soil disturbance than the other proposed methods. The possible effects of this treatment include reduced soil cover, decreased infiltration capacity, increased runoff, and increased erosion that could result in rilling or gullying, especially on steeper slopes or soils that are sensitive to disturbance. Increased sediment delivery that exceeds the streams' capacity to transport it could result in increased sedimentation. Water quality could also be affected if equipment leaks fuel or other fluids into a stream. The disturbance caused by dozer piling is expected to be greater than that caused by grapple piling. That is because the dozer would push the fuels into a pile, whereas an excavator would pick up and place fuels into a pile.

In areas of low soil burn severity, riparian buffers are anticipated to be largely intact and have ground cover capable of filtering sediment movement resulting from machine piling. In areas of moderate soil burn severity, riparian buffers may be variable. However, ground cover in the form of needle cast and resprouting vegetation can help filter runoff caused by machine piling disturbance. In areas of high soil burn severity little, if any, ground cover remained after the Rim Fire. However, two years post fire these areas have shown a dramatic increase in the amount of vegetation returning to these areas (Vegetation Chapter 3.13). This new vegetation can help filter sediment laden runoff resulting from the impacts of machine piling. In addition, management requirements state a minimum of 60% of well distributed ground cover should be left within 100 feet and to exclude dozer operations within 50 feet of a perennial streams, intermittent streams or SAF. Although it is anticipated that some sediment could reach streams as a result of machine piling, streamside buffers, needle cast, new and resprouting vegetation or placed ground cover should minimize this.

According to Reid (2010), the impacts of mechanical fuel treatments (similar to the site preparation activities proposed here), on erosion and sediment yield are likely to result from direct soil disturbance where these activities affect swales and low-order stream channels. In this project, swales have no riparian buffers since mechanized access is not prohibited. Ephemeral channels have a 15-foot buffer where equipment is excluded.

Roads

Forest roads cause hydrological effects by concentrating and channelizing surface and subsurface flow. Following wildfire, the ability of the landscape to filter runoff from roads can be reduced due to a decrease in ground cover (Peterson et al. 2009).

In this project area, road work was recently completed under previous projects and the effects are reflected in the existing condition of the project area. On road surfaces that are draining well, maintenance is important because a lack of road maintenance can result in progressive degradation of road-drainage structures and functions (USDA 2013a). This is particularly important with increased runoff from hillslopes following fire. In these situations, reconstruction is required to adequately improve drainage features and minimize impacts.

Erosion and sedimentation is anticipated along maintained and reconstructed roads. However, implementation of BMPs and management requirements are expected to minimize these effects. Road reconstruction may actually reduce erosion and sedimentation as this treatment would involve improving road drainage features.

Fuel Loading

Site preparation and thinning existing plantations would reduce the fuel loading in project area watersheds. Coarse woody debris would be reduced to about 20 tons per acre. This would result in lower flame lengths and fireline intensities, allowing for direct attack of future wildfires. Increased erosion following prescribed fire is related to the amount of vegetation removed. Prescribed burns, by design, do not consume extensive areas of organic matter (Baker 1990). Therefore, prescribed fires have little impact on erosion and sedimentation, whereas intense wildfires may have substantial impacts (Brooks et al. 1997). Reducing fuel loading and then maintaining this with prescribed fire has less potential for erosion and sedimentation than allowing fuel loading to increase as snags fall and having another large stand-replacing wildfire in the future. 3.05 Fuels has more information on fuel loading.

Riparian Vegetation

Riparian vegetation may be beneficially affected by the proposed action where thinning of trees in riparian areas are prescribed. Increasing sunlight in streamside areas provides an energy input that often stimulates regrowth of the riparian plant community. Riparian vegetation is often resilient even following wildfires (Ellis 2001, Dwire and Kauffman 2003, Beschta et al. 2004) and resprouting riparian vegetation such as willows and sedges is often observed quickly after the fire (note that in the Rim Fire, resprouting vegetation was observed in less than two weeks of actively burning at multiple riparian zones that burned at high intensity). Though this effect is largely a result of the fire removing stream shade cover and moisture competition, removal of tree boles may have a slight incremental effect. Another variable affecting riparian plant growth is the short-term increase in streamflow and near-stream ground water following a fire as a result of a reduction in plant transpiration due to tree mortality.

No fens are within treatment areas and would therefore not be affected.

Project activities along meadow edges are not expected to affect the 100 acres of meadows identified within the proposed action treatment units, as management requirements would be implemented.

This project identified the need to eradicate noxious weeds and invasive non-native pest plants in and adjacent to project units. Methods for removing noxious weeds include burning, grazing, grubbing, herbicides and hand pulling. Weed infestations near streams could potentially spread by wind, water, birds and other animals to new sites downstream. Once population of weeds and pest plants expand into riparian areas their potential to overtake desirable riparian species is high. This can lead to impairment of riparian function, increased sediment delivery, reduced quality of aquatic habitat, reduced flood control function and reduced function of soil water delivery to streams.

Stream Condition

Stream Flow

Water yield typically increases in the first year following wildfire due to a reduction in soil water storage, interception, and evapotranspiration when vegetation is killed. This change decreases with time as vegetation reoccupies a watershed (Peterson et al. 2009). Under Alternative 1, small and immeasurable hydrologic changes in canopy throughfall, plant transpiration and uptake processes would occur from removing, shredding and burning vegetation. Canopy openings and reduced fuel loading are expected to occur in SMZs as allowed under the mechanized equipment constraints of the BMP's in RCAs. The creation of canopy openings in SMZs may favor riparian vegetative species and potentially increase available soil moisture, during otherwise high transpiration periods.

Thinning activities will remove forest cover decreasing interception and transpiration and in wetter areas, increase annual water yields. The increases in annual water yield are proportional to the amount of forest cover removed, but at least 15 to 20% of the trees must be removed to produce a statistically detectable effect (MacDonald and Stednick 2003), and this project would remove at least that amount. The reduction in forest canopy also increases the amount of solar radiation that reaches the surface of the snow pack and the transfer of advective heat. These changes increase the rate of snowmelt and may alter the timing of peak runoff (MacDonald and Stednick 2003).

Planting seedlings would serve to improve the long-term watershed and riparian stability and function by enhancing and restoring the species diversity and structural composition of the forest surrounding riparian communities. Alternative 1 would restore or improve riparian RCA functions such as surface and subsurface filtering mechanisms. Planting trees would also increase live vegetation helping restore post-fire natural water storage, another positive watershed effect.

Modeling has indicated that increased surface roughness promotes infiltration and reduces overland flows, leading to reduced storm peak events and total flows (Smith et al. 2011). BMPs and management requirements under the proposed action would involve maintaining ground cover and minimizing compaction. Therefore, measurable changes in stream flow are not anticipated to result under the proposed action beyond the changes that already occurred as a result of the fire.

Stream Morphology

Prior to the Rim Fire, stream surveys throughout the project area indicated that most stream banks were stable and that channel form was predominately either normal (no active downcutting or evidence of accelerated past incision) or rejuvenating (evidence of legacy disturbance, but channel has recovered or is recovering to good condition).

Increased high peak flows following the Rim Fire have the potential to cause channel incision and stream bank erosion, primarily in low-gradient stream reaches with small, mobile substrate. However, measureable changes in flow are not anticipated as a result of the proposed action. Therefore, if channel incision does occur within the project area, it is likely the result of the fire or from large storms, not the proposed action.

Streambanks that were stable pre-fire may no longer have adequate cover to maintain their stability. This is particularly true in areas of high soil burn severity. As discussed above, riparian vegetation is resilient following fires and is expected to flourish in the post-fire conditions of increased sunlight and water. This would allow for natural recovery of bank stability. The effect of the proposed action on streambank stability is expected to be minimal. Mechanized equipment exclusion zones are applied to all streams so that equipment is only allowed on streambanks at designated crossing locations. Skid trail stream crossings are limited to two per mile on perennial and intermittent streams and three per mile on ephemeral streams. Management requirements to maintain or provide ground cover within 100 feet of perennial and intermittent streams would provide for stability while riparian vegetation continues recovering. Indirect effects that could occur in the case of increased flow or sediment delivery from adjacent hillslopes are also not expected, since hillslope effects would also be minimized by the implementation of project management requirements.

Large Woody Debris

Following wildfire, snags falling into streams may be the main source of wood to streams until trees in the post-fire riparian areas are large enough to fall into streams and create habitat (Reeves et al. 2006). Large woody debris (LWD) in and across channels typically helps to maintain channel stability, decrease flow velocity, trap sediment, and protect banks from erosion. The proposed thinning would not remove large existing snags and would primarily harvest smaller diameter trees (very few trees over 20 inches dbh exist within these stands). LWD recruitment would not be effected and the remaining trees would actually grow faster and become larger sooner. Given the quantity of large fire-killed trees that currently exist along streams in the project area, future recruitment is high and little potential for modification of its role in any subdrainage is likely. The role of LWD is less important in steep bedrock dominated systems such as these, where the wood does not form stable jams capable of trapping sediment for long periods of time (Berg et al. 1998). LWD recruitment in streams would increase in the long-term following project implementation.

Water Quality

Uses of water for the Tuolumne River from its source to New Don Pedro Reservoir are municipal and domestic supply, irrigation, stock watering, power, contact and non-contact recreation, warm and cold water freshwater habitat, and wildlife habitat. Existing uses of water for the Merced River from its source to McClure Lake are irrigation, power, contact and non-contact recreation, warm and cold water freshwater habitat, and wildlife habitat. A potential use for the Merced River is municipal and domestic water supply (CVRWQCB 2011). Beneficial uses are maintained when their related water quality objectives are met. Water quality objectives that could be affected by the proposed action are water temperature, sediment related parameters (sediment, settleable material, suspended material, and turbidity), and pesticides. There are no 303(d) listed impaired waterbodies within the project analysis area. This indicates that water quality is excellent at this large scale.

Water Temperature

Stream channel shade is highly influential in regulating water temperatures (Rutherford et al. 2004). Channel shade was reduced in portions of the project area where near-stream trees were killed by the fire. Elevated stream temperatures occur most frequently in mid- to late summer and early fall, when stream flows are at their lowest. Channel shading in seasonal channels has little influence on water temperature further downstream during these late season periods, because the seasonal streams are generally not flowing. Removal of the near-stream dead or live conifer trees on existing plantations is anticipated to have very little effect on stream shading. Even in drainages that could have an increase in water temperature (Corral Creek and Granite Creek), when the water reaches the Tuolumne River, it will mix with cooler water and the effect will be diluted. These small and localized effects would not affect beneficial uses in these drainages or downstream. Therefore, warm and cold water freshwater habitat would not be affected by the proposed action. In the long-term, planting conifer seedlings within riparian corridors would help to restore the shading component that was lost after the Rim Fire.

Sediment-Related Parameters

Ground-based treatments in RCAs would cause ground disturbance, due to tractor / heavy equipment use, skidding, and development and use of skid trails, and landings. Disturbed ground could result in increased erosion (erosion rates above pre-project levels). If project-generated erosion is delivered to a stream channel, that sedimentation could result in a water quality impact that would affect beneficial uses. For example, delivery of fine sediments from the project could decrease the quality of cold water fish habitat by filling pools and embedding spawning gravels. Some effects to water quality could result from ground disturbance associated with mechanical equipment treatments in unscoured swales that receive no SMZ buffers. These effects would consist of small, short-term (1-3 years) increases in sediment delivery to streams, which are not expected to be measurable. The project was designed to minimize or avoid these impacts, though management requirements including BMPs. Piling and burning of material near stream courses could contribute ash or sediment to streams. Ash can change the chemical properties of water if contributed in sufficient quantity. Water quality would be protected from potential effects of pile burning by locating burn piles outside of SMZs, which reduces the risk of ash from pile burning reaching the channels.

None of the sediment related beneficial uses of water should be impaired as a result of the proposed action. Minor, short-term increases in sediment related parameters are expected but not to the extent of adversely affecting beneficial uses. Anticipated sediment increases vary by watershed based on amount of project activity and watershed effects of the Rim Fire. None of the streams with special designations such as Wild and Scenic Rivers or Heritage Trout Waters are expected to be adversely affected. No known impairment of beneficial uses has occurred as a result of other past fire salvage harvesting on the Stanislaus in settings where the percentage of high soil burn severity was greater than the Rim Fire.

Herbicides

The risk of petrochemicals reaching streams would be reduced by implementing BMP 2.11, which requires that equipment servicing and refueling activities occur outside of RCAs. Suitable locations for such activities would be designated prior to project implementation.

Alternative 1 uses Glyphosate (trade name Accord® or equivalent) for reforestation treatments where competing vegetation cannot be effectively controlled by other means. The proposed action also includes a combination of hand pulling, digging, grazing, prescribed fire and herbicide applications of Glyphosate, Clopyralid, Aminopyralid and Clethodim to target noxious weeds.

Use of herbicides has the potential to expose areas of bare soil. In addition, manual treatments such as weed eating, pulling, and digging up weeds or competing vegetation may occur within buffers where herbicides are not allowed.

Potential water quality impacts are assessed based on the probable or reasonably expected concentrations that might be encountered in water following herbicide application as well as a worst case or spill scenario. Potential herbicide impacts include: 1) Herbicides directly entering water bodies by heavy storm runoff; 2) Accidental spill or fugitive drift from spray applications; 3) Localized erosion and transport of soil to water bodies due to loss of vegetation cover; and 4) Leaching of herbicides through specific soil types. These potential impacts are compared to State Water Quality Objectives and Federal Objectives.

Applicable objectives in the Water Board Basin Plan include:

1. No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses.
2. Discharges shall not result in pesticide concentrations in bottom sediments or aquatic life that adversely affect beneficial uses.
3. Pesticide concentrations shall not exceed those allowable by applicable anti-degradation policies.
4. Pesticide concentrations shall not exceed the lowest levels technically and economically achievable.

5. Waters designated for domestic or municipal supplies shall not contain concentrations of pesticides in excess of the Maximum Contaminant Levels (MCL) set forth in California Code of Regulations, Title 22 Division 4 Chapter 15.

Where more than one objective may be applicable, the most stringent objective applies (CVRWQCB, 2011). The most stringent numerical objective is to not exceed Maximum Contaminant Levels (MCL). The MCL for glyphosate is 0.7 mg/l or 700 ppb. MCLs have not been set in the California Code of Regulations for aminopyralid, clopyralid, and clethodim. The most stringent narrative objective is to "not exceed the lowest levels technically and economically achievable."

The Safe Drinking Water Act requires the EPA to determine safe levels of contaminants in drinking water which do or may cause health problems. EPA has set the MCL for glyphosate at 0.7 mg/l or 700 ppb (EPA 2010). MCLs have not been set for aminopyralid, clopyralid, and clethodim.

Management requirements, including buffer widths, were developed for herbicide use to protect water resources from contamination (Chapter 2.02).

Glyphosate

Glyphosate is a broad-spectrum foliar herbicide. It is proposed for use via a backpack sprayer and a 1-qt pressurized handheld sprayer. Glyphosate is relatively immobile in most soil environments as a result of its strong adsorption to soil particles. It also has low leaching potential. Glyphosate is inactivated in soil and water by microbial degradation. Soil studies have determined glyphosate half-lives ranging from 3-130 days (Schuette 1998). According to the specimen label, heavy rainfall soon after application may wash the product off of the foliage (Dow AgroSciences 2014).

Glyphosate Risk Assessment

A Human Health and Ecological Risk Assessment (worksheet version 6.00.13) was conducted for glyphosate (Human Health and Ecological Risk Report). Glyphosate for site preparation and release purposes is proposed in this project on approximately 26,036 acres. A total of approximately 1,739 acres of chemical treatment areas, or 6.7% of the total acres, are located within 100 feet of a perennial, intermittent or SAF. The values range from approximately 0.3 acres in the RCAs of the Miguel Creek-Eleanor Creek watershed to a maximum of 444 acres on the Jawbone Creek-Tuolumne River watershed. The project also proposed the use of glyphosate for weed eradication purposes on about 5,042 acres within the project area. This number is an overestimation since this does not take into consideration areas that would be treated with glyphosate for site preparation and release overlap with areas of noxious weeds species. A total of approximately 436 acres to be treated with glyphosate for weeds, or 9% of the total acres, are located within 100 feet of a perennial, intermittent or SAF. The values range from approximately 0.1 acres in the RCAs of the Upper South Fork-Tuolumne River to a maximum of 107 acres on the Lower Cherry Creek HUC 6 watersheds. With ground-based application and the use of buffers around drainages, these herbicides are not expected to enter surface water.

The risk assessment estimates the peak Expected Environmental Concentration (EEC) of glyphosate in water. Estimated concentrations range from 0.0065 mg/L to 0.415 mg/L. In addition, the peak EEC does not account for the dilution that would occur should the glyphosate reach a flowing stream, particularly one the size of, for example, Reed Creek, Clavey River, and the Tuolumne River. Therefore, even the lower end of the peak EEC range may overestimate concentrations in water.

The risk assessment also estimated concentrations in water at distances downwind after direct spray or after drift from backpack sprayers. A 10-foot buffer is proposed for the Rim Reforestation project when using Glyphosate near perennial waters, ephemeral streams, springs, seeps, or wet areas as well as near obligate riparian vegetation. Although a 10-foot distance is not modeled in the risk assessment for direct spray or after drift from backpack sprayers, direct spray into streams (0-foot buffer) and a 25-foot buffer are modeled. The proposed 10-foot buffer would have concentrations within this range.

Direct spray into a stream was estimated to have a concentration of 457 µg/L of glyphosate and a 25-foot buffer would have a concentration of 3.8 µg/L of glyphosate. The direct spray does not account for dilution in a stream, and therefore likely is an overestimate. Project management requirements limit wind speeds during spraying to 5 miles per hour.

Under both the peak EEC and direct spray or drift scenarios, concentrations of glyphosate in water would remain below the 0.7 mg/L MCL. In addition, toxicity values for tolerant cold water fish and amphibians would not be exceeded (Human Health and Ecological Risk Report, Worksheet G03). This means that even under the case of the accidental spill, glyphosate concentrations in water would be so low that no effect to aquatic species would be observed. This finding has been supported by monitoring data as described in the Watershed Report.

The Human Health and Ecological Risk Assessment estimated concentrations of glyphosate in pond water from an accidental spill (20 gallons) (worksheet B04b). Under this spill scenario, the concentration of glyphosate in water would be 1.14 mg/L. Although under this spill scenario the state and federal MCLs of 0.7 mg/L is somewhat exceeded, this is an overestimation because management requirements would prohibit the storage of herbicides on RCAs and require that mixing and loading be performed as far from water and on ground level as possible and on areas predetermined by the Contracting Officer Representative (Management Requirements, Chapter 2). In addition, the amount that a single backpack sprayer can handle is from 3 to 5 gallons. This means that even under the case of the accidental spill, glyphosate concentrations in water would be so low that no effect to water quality and aquatic species would be observed. Management requirements, such as buffer zones, were developed to further minimize the risk of and impact from a spill.

Clopyralid

Clopyralid is a selective (narrow-spectrum) foliar herbicide proposed for use via a backpack sprayer. It is effective in killing plants in the sunflower family and some legumes and buckwheat family plants. Clopyralid has a low soil adsorption coefficient and a very high movement rating. The very high movement ratings of clopyralid do not necessarily imply delivery to ground or surface waters in detectable amounts. The amount applied, the breakdown of the herbicide between application and precipitation, and streamside buffers ameliorate the potential for delivery. California’s dry summer climate means significant breakdown of the chemicals occurs in the time between spring application and fall rains. Persistence of clopyralid in soil is variable with documented half-lives ranging from 10 days to 10 months depending on soil type and climate. Although clopyralid does not bind readily to soil, it dissipates rapidly in some common soil conditions and typically is not expected to leach appreciably in non-sandy, low-to-moderate rainfall conditions. According to the specimen label, applications of Transline are rainfast within two hours after application (Dow AgroSciences 2011).

Clopyralid Risk Assessment

A Human Health and Ecological Risk Assessment (worksheet version 6.00.13) was conducted for clopyralid (Human Health and Ecological Risk Report). Clopyralid is proposed for noxious weeds eradication on 528 acres within the project area. This number is an overestimation since this does not take in consideration species overlaps that could be treated in the same area with other herbicides (i.e. glyphosate). A total of approximately 66.4 acres of chemical treatment areas, or 13% of the total acres, are located within a 100 feet of a perennial, intermittent or SAF. The values range from about 0.2 acres in the RCAs of the Upper Middle-Tuolumne River watershed to a maximum of 59 acres on the Lower Cheery Creek watershed. With ground-based application, the use of buffers around drainages and all other applicable BMPs (Chapter 2.02), this herbicide is not expected to enter surface water.

The risk assessment estimated the peak expected environmental concentration (EEC) of clopyralid in water. Estimated concentrations range from 0.005 mg/L to 0.07 mg/L. In addition, the peak EEC does not account for the dilution that would occur should the clopyralid reach a flowing stream, particularly one the size of, for example, the Clavey River and the Tuolumne River. Therefore, even the lower end of the peak EEC range may overestimate concentrations in water.

The risk assessment estimated concentrations in water downwind after direct spray or after drift from backpack sprayers by modeling at 0-foot buffer (direct spray into streams) and at 50-foot buffer. Under the 50 foot-buffer scenario, as proposed in this project near perennial waters, ephemeral streams, springs, seeps, or wet areas that have standing water at the time of application, the estimated concentration of clopyralid is 0.121 µg/L in pond water and 0.0989 µg/L in stream water (assuming the water was downwind of treatment site). This is a conservative estimate, and actual concentrations would be less. Direct spray into water with a 50-foot buffer is highly unlikely as the spray from the backpack sprayer would not reach that far. Project management requirements limit wind speeds during spraying to 5 miles per hour. In addition, vegetation within the 50-foot buffer would intercept drift spray, further reducing the likelihood of clopyralid reaching surface water.

The State and EPA have not established MCLs for clopyralid with which to compare the risk assessment values. However, project management requirements would reduce the risk of clopyralid reaching surface water.

The Human Health and Ecological Risk Assessment estimated concentrations of clopyralid in pond water under three different volumes of accidental spill ranging from 20 gallons to 200 gallons. Under these spill scenarios, concentrations of clopyralid in water would range from 0.056775 mg/L to 1.1355 mg/L. This exceeds the NOEC for aquatic macrophytes. However, these concentrations are higher than what would be expected should an accidental spill occur on the Rim Reforestation project. The accidental spill scenario is based off of spill into a pond, and there are no ponds in the project area that are near weed treatment sites. The highest risk site is a yellow star-thistle and tocalote site near Granite Creek within the Lower Cherry Creek HUC6 watershed. In the case of an accidental spill into the river, dilution would greatly reduce the concentrations of clopyralid in water. In addition, vegetation within the 50-foot no-spray would intercept the spill.

Runoff of clopyralid is most likely to occur as a result of heavy rainfall immediately after application. The likelihood of this occurring on the Rim Reforestation project is reduced due to the fact that application is not allowed when rain is forecast in the next 24 hours. In addition, clopyralid is considered rainfast after 2 hours (Dow AgroSciences 2011). Over 100 years of precipitation in Sonora, CA indicates that the likelihood of heavy precipitation decreases throughout the spring. Average precipitation in April, May, and June is 2.70, 1.24, and 0.30 inches respectively. The region's dry summer climate means that little, if any, precipitation would occur during the summer months, allowing for breakdown of clopyralid in the time between spring application and fall rains.

According to the SERA report, "clopyralid does not bind tightly to soil and thus would seem to have a high potential for leaching. While there is little doubt that clopyralid will leach under conditions that favor leaching – sandy soil, a sparse microbial population, and high rainfall – the potential for leaching or runoff is functionally reduced by the relatively rapid degradation of clopyralid in soil. A number of field lysimeter studies and a long-term field study indicate that leaching and subsequent contamination of ground water is likely to be minimal. "This conclusion is also consistent with a monitoring study of clopyralid in surface water after aerial application" (SERA 2004). BMPs were also designed to minimize the risk of leaching. This includes not applying clopyralid when soils are saturated and monitoring weather forecasts prior to application. Leaching is therefore unlikely to be a factor affecting water quality in this project.

The small amount of acreage proposed for treatment within 100 feet of a stream or SAF as well as the implementation of BMPs, including the use of buffers, limits on wind speed during application, and monitoring of weather and soil conditions prior to application, would minimize potential contamination of water. Therefore, the proposed application of clopyralid meets the State's narrative objective to “not exceed the lowest levels technically and economically achievable” in all instances except that of an accidental spill.

Aminopyralid

Aminopyralid is a new herbicide that has been registered provisionally as a reduced risk pesticide for the control of broadleaf weeds. It is proposed for use via a backpack sprayer. Aminopyralid is more mobile in soil than glyphosate, leading to a greater risk of this compound being translocated in the soil profile and possibly entering groundwater. Aminopyralid is likely to be non-persistent and relatively immobile in the soil profile (EPA 2005). Leaching below 6 to 12 inches (15 to 30 cm) is minimal (EPA 2005). The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in ground water contamination.

Aminopyralid Risk Assessment

A Human Health and Ecological Risk Assessment (worksheet version 6.00.13) was conducted for aminopyralid (Human Health and Ecological Risk Report). The Rim Reforestation project is proposing the use of aminopyralid for noxious weeds eradication purposes on approximately 546 acres within the project area. This number is an overestimation since this does not take in consideration species overlaps that could be treated in the same area with other herbicides (i.e. glyphosate). A total of about 61.3 acres of chemical treatment areas, or 11% of the total acres, are located within a 100 feet of a perennial, intermittent, or SAF. The values range from approximately 3.2 acres in the RCAs of the Lower North Fork-Tuolumne River watershed to a maximum of 37.5 acres on the Grapevine Creek-Tuolumne River watershed. With ground-based application, the use of buffers around drainages and all other applicable BMPs (Management Requirements, Chapter 2), this herbicide is not expected to enter surface water.

The risk assessment estimated the peak expected environmental concentration (EEC) of aminopyralid in water. Estimated concentrations range from 0.00022 mg/L to 0.066 mg/L. In addition, the peak EEC does not account for the dilution that would occur should the aminopyralid reach a flowing stream, particularly one the size of, for example, Lower North Fork-Tuolumne River and Lower South Fork-Tuolumne River. Therefore, even the lower end of the peak EEC range may overestimate concentrations in water.

The risk assessment estimated concentrations in water downwind after direct spray or after drift from backpack sprayers by modeling at 0-foot buffer (direct spray into streams) and at 50-foot buffer. Under the 50 foot-buffer scenario, as proposed in this project, the estimated concentration of aminopyralid is 0.0534 µg/L in pond water and 0.0435 µg/L in stream water (assuming the water was downwind of treatment site). This is a conservative estimate, and actual concentrations would be less. Direct spray into water with a 50-foot buffer is highly unlikely as the spray from the backpack sprayer would not reach that far. Project management requirements limit wind speeds during spraying to 5 miles per hour. In addition, vegetation within the 50-foot buffer would intercept drift spray, further reducing the likelihood of aminopyralid reaching surface water.

The State and EPA have not established MCLs for aminopyralid with which to compare the risk assessment values. However, the modeled concentrations of aminopyralid in water should not affect aquatic life.

The Human Health and Ecological Risk Assessment estimated concentrations of aminopyralid in pond water under three different volumes of accidental spill ranging from 20 gallons to 200 gallons. Under these spill scenarios, concentrations of aminopyralid in water would range from 0.024981 mg/L to 0.49962 mg/L. These concentrations remain below the NOEC for aquatic macrophytes. However, these concentrations are higher than what would be expected should an accidental spill occur. The accidental spill scenario is based off of spill into a pond, and there are no ponds in the project area that are near weed treatment sites. The highest risk areas are an Italian thistle, star-thistle and tocalote site near intermittent tributaries of Grapevine Creek within the Grapevine Creek-Tuolumne River HUC6 watershed. In the case of an accidental spill into the river, dilution would greatly reduce the concentrations of aminopyralid in water. In addition, vegetation within the 50-foot no-spray buffer would intercept the spill.

Clethodim

Clethodim is a selective post-emergence herbicide used for the control of annual or perennial grass weeds proposed for use via a backpack sprayer. Clethodim is of low persistence in most soils with a reported half-life of approximately 3 days (SERA 2014). Breakdown is mainly by aerobic processes, although photolysis may make some contribution. Volatilization loss and hydrolysis are probably not important processes in the soil breakdown of clethodim. The main breakdown products in soils under aerobic conditions are sulfoxide, sulfone and oxazole sulfone. Clethodim and these degradates are weakly bound to soils. Thus, while it may be somewhat mobile in the soil environment, it is very short-lived.

Clethodim Risk Assessment

A Human Health and Ecological Risk Assessment (worksheet version 6.00.13) was conducted for clethodim (Human Health and Ecological Risk Report). Clethodim is proposed for noxious weeds eradication on 3,002 acres within the project area. A total of 117 acres of chemical treatment areas, or 4% of the total acres, are located within a 100 feet of a perennial, intermittent, or SAF. The values range from 1.4 acres in the RCAs of the Grapevine-Tuolumne River watershed to a maximum of 1,253 acres in the Jawbone Creek-Tuolumne River watershed. With ground-based application, the use of buffers and all other applicable BMPs, this herbicide is not expected to enter surface water.

The risk assessment estimated the peak expected environmental concentration (EEC) of clethodim in water. Estimated concentrations range from 0.00000375 mg/L to 0.1325 mg/L. In addition, the peak EEC does not account for the dilution that would occur should the clethodim reach a flowing stream, particularly one the size of, for example, the Clavey River. Therefore, even the lower end of the peak EEC range may overestimate concentrations in water.

The risk assessment estimated concentrations in water downwind after direct spray or after drift from backpack sprayers by modeling at 0-foot buffer (direct spray into streams) and at 50-foot buffer. Under the 50 foot-buffer scenario, as proposed in this project near perennial waters, ephemeral streams, springs, seeps, or wet areas that have standing water at the time of application, the estimated concentration of clethodim is 0.121 µg/L in pond water and 0.0989 µg/L in stream water (assuming the water was downwind of treatment site). This is a conservative estimate, and actual concentrations would be less. Direct spray into water with a 50-foot buffer is highly unlikely as the spray from the backpack sprayer would not reach that far. Project management requirements limit wind speeds during spraying to 5 miles per hour. In addition, vegetation within the 50-foot buffer would intercept drift spray, further reducing the likelihood of clethodim reaching surface water.

The State and EPA have not established MCLs for clethodim with which to compare the risk assessment values. However, aquatic macrophytes are the most sensitive of all aquatic species analyzed. For aquatic macrophytes, data was only available for *Lemna gibba* on the risk assessment, and an NOEC of 0.3 mg/L was used for risk characterization. Because *Lemna* are monocots, this NOEC is presumed to apply to sensitive species of aquatic macrophytes. The risk assessment for clethodim estimated hazard quotients for the central and upper values as 1.3 and 4, respectively, indicating an elevated toxicological risk to aquatic macrophyte individuals under the accidental acute exposure scenario. However, project management requirements, would reduce the risk of clethodim reaching surface water.

The Human Health and Ecological Risk Assessment estimated concentrations of clethodim in pond water under three different volumes of accidental spill ranging from 20 gallons to 200 gallons. Under these spill scenarios, concentrations of clethodim in water would range from 0.056775 mg/L to 1.1355 mg/L. However, these concentrations are higher than what would be expected should an accidental spill occur on the Rim Reforestation project. The accidental spill scenario is based off of spill into a pond, and there are no ponds in the project area that are near weed treatment sites. The highest risk sites are medusahead sites near the intermittent Bull Meadow Creek and Alder Creek streams within the Lower Clavey River and the Jawbone Creek-Tuolumne River HUC6 watersheds, respectively. In the case of an accidental spill into the river, dilution would greatly reduce the concentrations of clethodim once it gets into the Tuolumne River, if not before. In addition, vegetation within the 50-foot no-spray would intercept the spill.

Clethodim Monitoring Data

There is a general lack of monitoring data on clethodim in surface water and groundwater. This is a limitation in the risk assessment and a source of uncertainty. The lack of monitoring data reflects the fact that clethodim is a relatively new herbicide. But, based on literature review, there is very little risk posed to water quality from this herbicide application in the Rim Reforestation project. In order to ensure compliance with the Forest Plan monitoring would be done when herbicide applications occur within RCAs and SMZs (USDA 2002).

Herbicide Surfactants

Syl-tac™

According to the Syl-tac™ label, the product should not exceed 5% of the finished spray volume. The project is proposing to use for Syl-tac (0.4%). Due to the small amount of surfactant being used and stream buffers being applied, it is unlikely that the toxicity levels would be exceeded.

Colorfast™ Purple

Colorfast™ Purple dye is not required to be registered as a pesticide and contains no toxic chemicals (USDA 1997). Due to the small amount of dye being used and stream buffers being applied, it is unlikely to get in the water.

CUMULATIVE EFFECTS

The process for analyzing cumulative watershed effects (CWE) consists of two steps: 1) An office evaluation to determine the risk of cumulative effects using a predictive model and researching watershed history and 2) Field evaluation of stream course indicators of cumulative effects.

Step 1, the risk of cumulative effects, is evaluated using the Forest Service ERA methodology, adopted by Region 5 as a method of addressing cumulative watershed effects (USDA 1990). A description of the ERA methodology can be found in Appendix A: Cumulative Watershed Effects Analysis Methodology of the Watershed Report.

Step 2, field evaluation, is necessary for comparing the modeled ERA prediction with actual and expected future field conditions. Project-related water quality parameters and watershed condition are evaluated via in-stream and near-stream indicators of condition. This evaluation is essential to help interpret cumulative effects of past projects and potential cumulative effects given proposed activities and other reasonably foreseeable future activities. Field review was used to verify that the geographic and temporal extent of analysis was adequate for evaluation of cumulative watershed effects (Connaughton 2005).

Equivalent Roaded Acres (ERAs)

The CWE ERA analysis was conducted on all lands (public and private) using the activities listed in Appendix B within 13 HUC 6 and 5 HUC 7 level watersheds. GIS analysis was used to calculate acreages of activities in the watersheds. ERA values for these activities were summed and then were compared to a Threshold of Concern (TOC). The TOC range for all HUC 6 and HUC 7 watersheds analyzed was 12 to 14%. Table 3.15-7 gives a summary of ERA values by watershed.

Table 3.15-7 Alternative 1: Annual Percent ERA for HUC 6 and HUC 7 Analysis Watersheds

HUC Level and Name	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
6. Grapevine Creek-Tuolumne River	2.63	2.46	2.34	2.27	2.24	2.02	1.84	1.63	1.48	1.42
6. Jawbone Creek-Tuolumne River	13.41[1]	12.32[1]	11.38	9.44	7.53	6.62	5.32	4.08	2.87	2.32
7. Corral Creek	22.37[1]	23.03[1]	23.01[1]	19.36[1]	15.27[1]	12.99[1]	10.63	8.27	5.59	4.01
7. Lower Jawbone Creek	10.65	9.35	8.64	7.43	5.83	5.14	4.20	3.52	2.78	1.95
6. Lower North Fork Tuolumne River	3.19	2.94	2.79	2.60	2.36	2.17	1.98	1.79	1.66	1.64
6. Lower Clavey River	8.41	7.92	7.26	6.15	5.52	4.73	3.93	2.97	2.16	1.75
7. Bear Springs Creek	12.09[1]	11.76	10.93	9.76	8.86	8.12	7.48	6.82	6.23	1.62
6. Middle Clavey River	5.29	4.88	5.22	5.47	4.78	4.20	3.63	3.08	2.55	2.15
6. Reed Creek	8.12	7.51	6.90	6.06	5.07	4.52	3.95	3.23	2.56	2.20
7. Lower Reed Creek	14.55[1]	12.95[1]	11.17	8.88	6.99	6.25	5.54	4.35	3.33	2.92
6. Lower Cherry Creek	7.71	6.79	6.09	5.05	4.00	4.05	3.35	2.71	2.08	1.82
7. Granite Creek	18.85[1]	16.45[1]	15.40[1]	12.72[1]	9.66	8.45	6.71	5.30	4.04	3.47
6. Miguel Creek-Eleanor Creek	1.25	1.03	0.80	0.55	0.31	0.29	0.25	0.22	0.18	0.16
6. Poopenaut Valley-Tuolumne River	2.04	1.73	1.40	1.05	0.70	0.63	0.57	0.51	0.46	0.42
6. Lower Middle Fork Tuolumne River	13.23[1]	12.47[1]	11.67	10.68	9.29	7.95	6.72	5.27	4.04	3.05
6. Upper Middle Fork Tuolumne River	1.76	1.38	1.01	0.63	0.25	0.22	0.19	0.16	0.14	0.12
6. Lower South Fork Tuolumne River	8.40	7.84	7.47	6.72	6.13	5.40	4.62	3.84	3.14	2.66
6. Upper South Fork Tuolumne River	1.54	1.35	1.15	0.97	0.81	0.76	0.73	0.69	0.66	0.64

[1] Denotes watersheds over the TOC

Previous analyses on the Forest indicate the effects of livestock grazing at the watershed scale are very low. Ground disturbance from livestock grazing is essentially a site issue rather than a watershed scale issue. This is because the spatial impacts of livestock grazing are much higher in low gradient stream channels through meadows than in upland areas, and low gradient stream areas make up an extremely small percentage of the watershed acreage in this project. This results in negligible change to ERA values. Because of this, cumulative impacts of grazing are described narratively for this project.

HUC 6 and 7 Watersheds

Management requirements and BMPs were proposed to maintain or improve current conditions in the watersheds. This includes maintenance of a minimum of 60% well distributed ground cover within a 100 feet of a perennial stream, intermittent stream, or SAF and exclusion zones for ground-based equipment. Effectiveness monitoring is done annually on projects throughout the forest at randomly selected sites to determine if BMPs were effective. The Water Board requires that additional monitoring beyond effectiveness monitoring be conducted on watersheds (both HUC 6 and HUC 7) over the TOC with commercial timber related activities. Forensic monitoring inspections are conducted during the winter period. These inspections are designed to detect potentially significant sources of pollution such as failed management measures or natural sources. The goal of winter forensic monitoring is to locate sources of sediment production in a timely manner so that rapid corrective action may be taken where feasible and appropriate (CVRWQCB 2014). Under this project, the majority of the thinning units within the watersheds over the TOC are located on areas that may be inaccessible during the winter. In such situations, forensic monitoring would be conducted during spring runoff, as this is the time when erosion is most likely.

The Rim Recovery project was also required to conduct forensic monitoring on the watersheds that exceeded the TOC and would continue doing it until all the activities and waiver conditions have been met under that project. Under this project 2 HUC 6 and 4 HUC 7 watersheds exceeded the TOC. These watersheds are the same watersheds that exceeded the TOC under Rim Recovery with the exception of the Lower Jawbone Creek HUC7 watershed that remained under TOC under this project. All of the rest of the analysis watersheds under this project were well below the TOC (Table 3.15-7).

A project specific monitoring plan will be developed to ensure compliance with the State Water Board timber waiver and the Region 5 Forest Service Water Quality Management Handbook.

Stream condition in the project area watersheds was evaluated to identify indications of past or present cumulative effects, and the potential for adverse impacts from future cumulative effects. The evaluation of stream condition included pre-fire stream surveys in most watersheds following the StreamScape Inventory (SSI) Protocol, which included observations of streambed sediment, streambank stability, and attributes of stream morphology (Frazier et al. 2008).

All watersheds which exceeded the TOC are discussed in detail below.

Jawbone Creek-Tuolumne River (HUC 6) and Corral Creek (HUC 7)

ERA Summary

Under Alternative 1, the ERA in the Jawbone Creek-Tuolumne River watershed would increase from its current 13.24% (no action) to 13.41%, its maximum ERA, in the first year of implementation, 2016. The ERA falls back below the TOC by 2018 and by 2025 is down to 2.32%. The previous activities in the watershed, which have an ERA value of 10.64% in 2016, are large contributors to the high ERA values. These activities include the fire itself, fire suppression, timber harvest on private and NFS lands before the fire and salvage activities on private and NFS lands after the fire.

The ERA in the Corral Creek HUC 7 watershed would increase from its current 22.04% (no action) to 22.37% in the first year of implementation, 2016. This would further increase in 2017, with a maximum ERA of 23.03%. The ERA falls back below the TOC by 2022 and by 2025 is down to 4.01%. The ERA is over the 12 to 14% threshold of concern for this watershed. This is due mainly to the previous activities in the watershed, which have an ERA value of 17.26%. Land management activities in the watershed include salvage activities post fire (Rim HT and Rim Recovery projects) and private salvage activities. However, the main reason the previous ERA was so high was because 89% of the watershed burned at high or moderate soil burn severity.

Stream Condition Summary

Pre-fire stream surveys in the Jawbone Creek-Tuolumne River watershed were conducted in Drew Creek and Corral Creek. Surveys indicated that the condition of Drew Creek was good overall (i.e., stable banks, normal channel morphology, and low pool bed sediment). The RCA surrounding Drew Creek burned at low severity, so stream condition post-fire is likely the same as pre-fire. Very little treatment is proposed under Alternative 1 in the southern part of the Jawbone Creek-Tuolumne River watershed near Drew Creek, so stream condition is anticipated to remain good.

Pre-fire stream surveys in Corral Creek, on the other hand, showed much of the channel to be rejuvenating from past disturbance. Pre-fire bank stability was moderate, and was substantially reduced by the fire. This stream is still sensitive to further disturbance. Due to this sensitivity, additional management requirements were put in place for Corral Creek. A large equipment exclusion zone prohibits mechanized equipment between Corral Creek and its near-stream roads. Ground cover will be maintained or provided along its banks to minimize erosion and increase stability. This is in addition to 700 acres of straw mulch that was applied to the watershed as part of BAER treatments. Despite these treatments, Corral Creek is one of the areas which have the greatest potential for stream sedimentation following treatment.

The proposed action is anticipated to result in increased sedimentation in the Jawbone Creek-Tuolumne River watershed, particularly in the Corral Creek HUC 7 watershed. However, management requirements and BMPs are anticipated to minimize these effects to the extent feasible. Monitoring is anticipated to identify any problem areas so that corrective action could be taken quickly. Due to these measures, the proposed action is not anticipated to result in adverse off-site cumulative effects to sediment-related water quality parameters or to watershed condition (i.e. degradation of stream channel morphology, accelerated erosion or loss of soil productivity).

Bear Springs Creek (HUC 7)

ERA Summary

The ERA in the Bear Springs Creek HUC 7 watershed would increase from its current 11.79% (no action) to 12.09% in the first year of implementation, 2016. This is the maximum ERA. The ERA falls back below the TOC the following year 2017 and by 2025 is down to 1.62%. The ERA is slightly over the 12 to 14% threshold of concern for this watershed. This is due mainly to the previous activities in the watershed, which have an ERA value of 9.89%. These previous activities include the fire itself, in which 50% of the watershed burned at moderate or high soil burn severity, as well as salvage activities on NFS land and timber activities (both green tree sales and salvage) on private lands.

Stream Condition Summary

Pre-fire stream surveys were not conducted in the Bear Springs Creek HUC 7 watershed. However, the acreage of high soil burn severity in this watershed was low (7%). Only 2% high soil burn severity occurred within 100 feet of streams, meaning that most of the high soil burn severity was on the hillslopes. In the Bear Springs Creek watershed, mechanical activities are not proposed in a high soil burn severity area within 100 feet of a perennial stream, intermittent stream, or SAF, but are proposed on only 3 acres within moderate soil burn severity. Due to low acreage of treatment proposed within moderate soil burn severity and zero acreage within the highest risk area, the creation of effective sediment transport networks to stream channels are not expected. Due to implementation of management requirements and BMPs, as well as monitoring to identify problem areas, the proposed action is not anticipated to result in adverse off-site cumulative effects to sediment-related water quality parameters or to watershed condition (i.e. degradation of stream channel morphology, accelerated erosion or loss of soil productivity).

Lower Reed Creek (HUC 7)

ERA Summary

The ERA in the Lower Reed Creek HUC 7 watershed would increase from its current 14.46% (no action) to a maximum 14.55% in the first year of implementation, 2016. The ERA falls back below the TOC by 2018 and by 2025 goes down to 2.92%. The ERA is over the 12 to 14% threshold of concern for this watershed. This is due mainly to the previous activities in the watershed, which have an ERA value of 11.71% in 2016. These previous activities include the fire itself, in which 62% of the watershed burned at moderate or high soil burn severity, as well as timber activities (both green tree sales and salvage) on private and NFS lands.

Stream Condition Summary

Reed Creek and Niagara Creek are the main channels in the Lower Reed Creek watershed. Reed Creek had high bank stability pre-fire and had 99% of its length in a normal channel form. Niagara Creek had more evidence of past instability, with sections of low bank stability (6% of surveyed length) and almost half its length incised, incised and widened, or rejuvenating. Despite this, both streams had low pool bed and pool tail sediment.

In the Lower Reed Creek watershed, 11 acres of mechanical activities are proposed in high soil burn severity areas within 100 feet of a perennial stream, intermittent stream, or SAF. Reed Creek is bedrock controlled and highly erosion resistant, so changes in stream channel form are unlikely. Niagara Creek is more sensitive to disturbance, as its dominant substrate is gravel which is much more easily mobilized in high flows. Management requirements and BMPs were designed to address this sensitivity. This includes equipment exclusion zones and ground cover requirements. In addition, about 1,900 acres of straw mulch was applied to this watershed as part of BAER treatments. Despite these treatments, the Lower Reed Creek HUC 7 watershed is one of the areas which have the greatest potential for stream sedimentation following treatment.

The proposed action is anticipated to result in a slightly increased sedimentation in the Lower Reed Creek watershed. However, management requirements and BMPs are anticipated to minimize these effects to the extent feasible. Monitoring is anticipated to identify any problem areas so that corrective action could be taken quickly. Due to these measures, the proposed action is not anticipated to result in adverse off-site cumulative effects to sediment-related water quality parameters or to watershed condition (i.e. degradation of stream channel morphology, accelerated erosion or loss of soil productivity).

Granite Creek (HUC 7)

ERA Summary

The ERA in the Granite Creek HUC 7 watershed would stay on its current 18.85% (no action) to the maximum 18.85% in the first year of implementation, 2016. The ERA falls back below the TOC by 2020 and by 2025 is down to 3.47%. The ERA is over the 12 to 14% threshold of concern for this watershed. This is due primarily to the previous activities in the watershed, which have an ERA value of 15.42% in 2016. These previous activities include the fire itself, in which 92% of the watershed burned at moderate or high soil burn severity, as well as timber activities (both green tree sales and salvage) on private and NFS lands.

Stream Condition Summary

No pre-fire SSI data was collected for the Granite Creek watershed. In this watershed, 54 acres of mechanical activities are proposed in high soil burn severity area within 100 feet of a perennial stream, intermittent stream, or SAF. The granitic soil prevalent in this watershed is highly erodible. About 30% of the watershed burned at high soil burn severity, and an additional 62% burned at moderate soil burn severity. Because of this sensitivity, about 750 acres of straw mulch was applied to the Granite Creek watershed as part of BAER treatments.

The proposed action is anticipated to result in increased sedimentation in the Granite Creek watershed. This watershed experienced the greatest burn severity of any of the HUC 7 watersheds. However, management requirements and BMPs are anticipated to minimize these effects to the extent feasible. Monitoring is anticipated to identify any problem areas so that corrective action could be taken quickly. Due to these measures, the proposed action is not anticipated to result in adverse off-site cumulative effects to sediment-related water quality parameters or to watershed condition (i.e. degradation of stream channel morphology, accelerated erosion or loss of soil productivity).

Lower Middle Fork Tuolumne River (HUC 6)

ERA Summary

The ERA in the Lower Middle Fork Tuolumne River watershed would increase from its current 12.57% (no action) to the maximum 13.23% in the first year of implementation, 2016. The ERA falls back below the TOC by 2018 and by 2025 is down to 3.05%. The ERA is over the 12 to 14% threshold of concern for this watershed. This is due mainly to the previous activities in the watershed, which have an ERA value of 9.53% in 2016. These previous activities include the fire itself, of which 63% of the watershed burned at moderate or high soil burn severity, as well as timber activities on private and NFS lands.

Stream Condition Summary

Nearly 10 miles of pre-fire stream survey data was collected on the main channel of the Middle Fork Tuolumne River. Bank stability was very high and channel form was normal for its entire length, indicating no evidence of past channel incision. Pool tail and pool bed fine sediment was also low. In this watershed, 16 acres of mechanical activities are proposed in high soil burn severity area within 100 feet of a perennial stream, intermittent stream, or SAF. Part of this watershed was burned previously in the Pilot Fire, and good pre-Rim Fire condition indicates that impacts of past wildfire have not affected stream channel stability. The areas of high soil burn severity in the Lower Middle

Fork Tuolumne River watershed were relatively small patches well distributed throughout the watershed. The spatial mosaic of severity classes can reduce on and off site soil and water effects by interrupting erosion pathways and reducing sediment delivery to streams.

The proposed action is anticipated to result in increased sedimentation in the Lower Middle Fork Tuolumne River watershed. However, management requirements and BMPs are anticipated to minimize these effects to the extent feasible. Monitoring is anticipated to identify any problem areas so that corrective action could be taken quickly. Due to these measures, the proposed action is not anticipated to result in adverse off-site cumulative effects to sediment-related water quality parameters or to watershed condition (i.e. degradation of stream channel morphology, accelerated erosion or loss of soil productivity).

Grazing

Active grazing allotments are located in all of the analysis HUC 6 and HUC 7 watersheds except Miguel Creek-Eleanor Creek. Grazing on these allotments has the potential to slow recovery of riparian vegetation and increase ground disturbance, particularly along streambanks. However, Forest Plan Standards and Guidelines require the prevention of disturbance from livestock from exceeding 20% of stream reach or 20% of natural lake and pond shorelines. It also limits browse to no more than 20% of the annual leader growth on mature riparian shrubs and no more than 20% of individual seedlings. In this project area the browse limit would apply to streamside areas where riparian obligate trees and shrubs are naturally resprouting and reseeding after the fire. Although continuing of grazing is anticipated to result in ground disturbance and a reduction in riparian vegetation, these effects are anticipated to be localized and adherence to Standards and Guidelines should allow for riparian vegetation recovery to progress naturally.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

Under the no action alternative, current management plans would continue to guide management of the project area and all conditions would remain the same as those shown in the Affected Environment. Hydrologic and erosional responses to the fire would continue to occur. No reforestation, deer habitat enhancement or noxious weed eradication would be implemented to accomplish the purpose and need of the Rim Reforestation Project.

Large areas of the fire where all or most of the conifers were killed would be left to recover naturally, which could take many decades.

Alternative 2 does not serve to improve the long-term watershed and riparian stability and function by enhancing and restoring the species diversity and structural composition of the forest surrounding riparian communities and adjacent hillslopes. Alternative 2 does not help restore or improve RCAs and adjacent hillslopes functions as a filtering or shading mechanism.

Erosion and Sedimentation

Soil Compaction

Under the Alternative 2, no additional soil compaction would occur. However, activities under the action alternatives designed to reduce soil compaction would also not occur. Field review and LiDAR imagery indicates an extensive skid trail network within the project area. Many of these pre-existing skid trails were not properly decommissioned in the past and thus are concentrating runoff and causing erosion and sedimentation. Under the action alternatives, existing skid trails would be re-used to the extent practicable, and then subsoiled and waterbarred, reducing compaction and the risk of erosion and sedimentation. This would not occur under Alternative 2.

Soil Displacement

Soil displacement would not be increased by proposed activities under Alternative 2.

Ground Cover

Erosion resulting from the winter of 2015/16 will be a small increment over that from the Rim Fire following the winter of 2013/14. Post-fire observations on past fires on the Stanislaus show that the most substantial amount of erosion usually occurs during the first winter after the fire. The erosion rates will continue decreasing as a result of additional needle cast and growth of live cover. Over time, trees falling would increase ground cover in many areas. Live vegetative recovery would increase over time under the no action alternative. This recovery is anticipated to be faster than under the action alternatives because disturbance by heavy equipment would not occur. Groundcover would recover the most slowly in High SBS areas, with erosion the most likely in these areas.

Mechanized Equipment Activities

Thinning and mechanical site preparation activities as proposed in the action alternatives have the potential to create more sediment transport networks to stream channels. These transport networks would not be created under Alternative 2. However, existing sediment transport networks would also not be mitigated by subsoiling under Alternative 2, as they would be under the action alternatives.

Piling and Burning

No piling and burning would occur under Alternative 2, so there is no risk of further erosion and sedimentation from these activities.

Roads

Forest roads cause hydrological effects by concentrating and channelizing surface and subsurface flow. Following wildfire, the ability of the landscape to filter runoff from roads can be reduced due to a decrease in ground cover (Peterson et al. 2009). Any existing issues would continue to occur under Alternative 2.

The increased overland flow rates and sediment yields associated with road reconstruction and maintenance would not occur under Alternative 2. In addition, no roads would be improved through these activities, allowing existing problems to persist.

Fuel Loading

The no action alternative would allow for fuel loading to increase in the project area. Nearly all snags would be expected to fall by 20 years post-fire. The limbs and boles from these fallen trees would accumulate as surface fuels. This fuel is expected to increase each decade as trees fall over.

Increased erosion following fire is related to the amount of vegetation removed. Prescribed fires, by design, do not consume extensive areas of organic matter (Baker 1990). Therefore, they have little impact on erosion and sedimentation, whereas intense wildfires may have substantial impacts (Brooks et al. 1997). Higher fuel loadings, projected to occur under Alternative 2, would not be maintained with prescribed fire. A future reburn under higher fuel loadings would likely lead to soil erosion and sedimentation more severely than that caused by the reduction of fuel loading during site preparation activities under the action alternatives and maintaining these reduced loadings in the future by utilizing prescribed fire.

Riparian Vegetation

Under Alternative 2, riparian vegetation would not be disturbed. However, the thinning of trees in riparian areas would increase sunlight to these species, and this would not occur under Alternative 2.

Stream Condition

Stream Flow

Under Alternative 2, there would be no measurable changes in stream flow. Soil compaction from management activities, which can reduce infiltration and increase runoff to streams, would not occur. However, activities under the action alternatives designed to reduce soil compaction would not occur either. There would be no hydrologic changes in canopy throughfall, plant transpiration and uptake processes from removing, shredding and burning vegetation.

Stream Morphology

No changes in stream morphology are anticipated. Bank stability would increase over time as live vegetation continued to recover.

Large Woody Debris

Levels of large woody debris (LWD) in streams would be high under Alternative 2 as existing snags and dying trees would be retained and over time many near-stream snags would fall into streams. The effect of this high level of LWD on stream condition is uncertain. In streams with low levels of LWD this extra loading may be beneficial in storing stream sediment. In streams with high levels of LWD, this extra loading may be excessive. Larger rivers should be capable of transporting these high loads of LWD to downstream reservoirs.

Water Quality

Water Temperature

Under Alternative 2, thinning would not occur allowing stream shading to increase, maintaining cool water temperatures over time.

Sediment-Related Parameters

Ground disturbance from mechanized equipment that could lead to stream sedimentation would not occur under Alternative 2. However, activities that could reduce stream sedimentation, such as mastication and subsoiling of existing skid trails, would not occur.

Chemicals

Herbicides would not be used under Alternative 2.

Summary

Beneficial uses of water would continue to be met.

CUMULATIVE EFFECTS

Equivalent Roaded Acres (ERAs)

Table 3.15-8 shows ERAs calculated for 13 HUC 6 and 5 HUC 7 watersheds.

HUC 6 and 7 Watersheds

ERAs exceed the threshold of concern in 2 HUC 6 and 3 HUC 7 watersheds under the no action alternative. These high values can be attributed to the fire itself as well as past and future management activities on private and NFS lands.

Grazing

Same as Alternative 1.

Table 3.15-8 Alternative 2: Annual Percent ERA for HUC 6 and HUC 7 Analysis Watershed

HUC Level and Name	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
6. Grapevine Creek-Tuolumne River	2.63	2.46	2.27	2.07	1.88	1.73	1.59	1.44	1.30	1.28
6. Jawbone Creek-Tuolumne River	13.24[1]	11.51	9.84	7.97	6.21	5.11	4.02	2.93	2.02	1.67
7. Corral Creek	22.04[1]	19.62[1]	17.03[1]	13.73[1]	10.42	8.59	6.78	4.97	3.16	2.29
7. Lower Jawbone Creek	10.65	9.18	8.11	6.79	5.47	4.66	3.87	3.08	2.50	1.83
6. Lower North Fork Tuolumne River	3.19	2.94	2.71	2.48	2.27	2.10	1.93	1.75	1.62	1.61
6. Lower Clavey River	8.29	7.48	6.61	5.58	4.60	3.81	3.03	2.29	1.58	1.24
7. Bear Springs Creek	11.79	11.06	10.19	9.13	8.19	7.56	6.93	6.41	5.93	1.39
6. Middle Clavey River	5.29	4.87	5.19	5.40	4.73	4.15	3.58	3.03	2.50	2.11
6. Reed Creek	8.09	7.34	6.65	5.87	4.84	4.16	3.49	2.82	2.25	1.89
7. Lower Reed Creek	14.46[1]	12.38[1]	10.36	8.26	6.25	5.21	4.18	3.15	2.45	2.05
6. Lower Cherry Creek	7.71	6.70	5.66	4.59	3.54	2.98	2.42	1.87	1.41	1.26
7. Granite Creek	18.85[1]	15.91[1]	13.02[1]	10.17	7.44	6.14	4.83	3.52	2.67	2.48
6. Miguel Creek-Eleanor Creek	1.25	1.03	0.80	0.55	0.31	0.28	0.24	0.20	0.17	0.15
6. Poopenaut Valley-Tuolumne River	1.92	1.62	1.29	0.96	0.62	0.56	0.51	0.47	0.43	0.41
6. Lower Middle Fork Tuolumne River	12.57[1]	11.54	10.32	8.81	7.36	6.23	5.11	4.02	2.99	2.32
6. Upper Middle Fork Tuolumne River	1.73	1.35	0.98	0.59	0.21	0.19	0.17	0.15	0.13	0.11
6. Lower South Fork Tuolumne River	8.37	7.78	7.23	6.26	5.37	4.68	3.99	3.31	2.65	2.21
6. Upper South Fork Tuolumne River	1.53	1.33	1.13	0.93	0.74	0.71	0.68	0.64	0.62	0.60

Alternative 3

Alternative 3 would not include use of herbicides. Instead, site preparation, treatment of noxious weeds and release of planted seedlings would be accomplished using manual treatments or heavy equipment.

DIRECT AND INDIRECT EFFECTS

Erosion and Sedimentation

Direct and indirect effects from all of the treatments described in Alternative 1 would be the same for Alternative 3, with the differences described below.

The effects described for the use of glyphosate, aminopyralid, clopyralid, and clethodim do not apply to Alternative 3.

Additional mechanical site preparation would increase ground disturbance and the risk of erosion and sediment delivery to streams slightly; however, because these activities would comply with all specified management requirements including BMPs, any additional impacts are expected to be minimal. Additional hand release would have no effects on watershed resources due to the localized and minor disturbance that results from this treatment. Overall effects of the array of mechanical treatments would be the same as described under Alternative 1.

Treating noxious weeds with mechanical methods would produce different effects than the use of herbicides. As part of the Integrated Pest Management Approach (IPM), 1,127 and 1,173 acres of prescribed fire would treat medusahead grass and other weed species on the Jawbone Creek-Tuolumne River and Lower Clavey River watersheds, respectively. Prescribed fire would also require fire line construction. The burn would be followed by targeted grazing or additional grubbing. The management requirements developed for these actions would minimize effects. While tilling has a greater risk of causing erosion than other mechanical treatments; however, assuming that BMPs and other management requirements are implemented, potential impacts to water quality would be minor and localized to the adjacent stream reach.

Mechanized Equipment Activities

Table 3.15-9 shows mechanical activities acres (thin/biomass, machine piling, mastication, deep tilling and forest cultivation) within 100 feet of perennial or intermittent streams and SAFs by soil burn severity.

Table 3.15-9 Alternative 3: Mechanical Activities by Soil Burn Severity

HUC Level and Name	SBS HIGH	SBS MOD	SBS LOW
6. Grapevine Creek-Tuolumne River	0	26	46
6. Jawbone Creek-Tuolumne River	69	125	99
7. Corral Creek	33	47	7
7. Lower Jawbone Creek	1	27	3
6. Lower North Fork Tuolumne River	0	19	20
6. Lower Clavey River	3	59	34
7. Bear Springs Creek	3	12	5
6. Middle Clavey River	0	11	11
6. Reed Creek	13	20	16
7. Lower Reed Creek	13	18	6
6. Lower Cherry Creek	70	148	45
7. Granite Creek	56	84	3
6. Miguel Creek-Eleanor Creek	0	0	2
6. Poopenaut Valley-Tuolumne River	4	4	0
6. Lower Middle Fork Tuolumne River	26	143	53
6. Upper Middle Fork Tuolumne River	0	6	6
6. Lower South Fork Tuolumne River	5	48	48
6. Upper South Fork Tuolumne River	0	0	3

LOW=Low and Unburned; MOD=Moderate; SBS=Soil Burn Severity (percent of Fire area)

Despite implementation of BMPs and management requirements, increased stream sedimentation is anticipated as a result of Alternative 3, particularly in areas where mechanical activities create more effective sediment transport networks to stream channels. This is more likely to occur in the Jawbone Creek-Tuolumne River, Corral Creek, Lower Cherry Creek, and Granite Creek watersheds than in other HUC 6 or HUC 7 watersheds due to the larger acreages of high soil burn severity areas near streams proposed for treatment. Under these 4 watersheds and this Alternative 3, mechanical activities acres on high soil burn severity would increment slightly when compared with Alternative 1. Jawbone Creek-Tuolumne River goes from 68 to 69 acres, Corral Creek from 32 to 33 acres, Lower Cherry Creek from 66 to 70 acres, and Granite Creek from 54 to 56 acres.

CUMULATIVE EFFECTS

Equivalent Roaded Acres (ERAs)

ERAs were calculated for 13 HUC 6 and 5 HUC 7 watersheds. Results of these analyses vary from that found under Alternative 1 since increases in mechanical treatment would create higher ERAs. Table 3.15-10 shows the ERA values for Alternative 3.

HUC 6 and 7 Watersheds

ERA values for 7 of the 13 HUC 6 watersheds were equal or slightly higher for Alternative 3 than Alternative 1. These are Grapevine Creek-Tuolumne River, Lower North Fork-Tuolumne River, Middle Clavey River, Miguel Creek-Eleanor Creek, Poopenaut Valley-Tuolumne River, Upper Middle Fork-Tuolumne River and Upper South Fork-Tuolumne River watersheds. Of those 7 watersheds, Grapevine Creek-Tuolumne River would have the higher increase with up to 0.17% in 2023 for Alternative 3. Eleven HUC 6 and HUC 7 watersheds had higher ERA values than Alternative 1. The largest increase would occur in 2021 with up to 4.61 in the Corral Creek watershed under Alternative 3. ERA increases were attributed primarily to the additional deep tilling and forest cultivation and manual grubbing treatments added under this Alternative 3.

Although there are differences in ERA values between Alternative 1 and Alternative 3, the watersheds that exceeded the TOC were the same. Therefore, cumulative effects for Alternative 3 are anticipated to be the same as described for Alternative 1.

Table 3.15-10 Alternative 3: Annual Percent ERA for HUC 6 and HUC 7 Analysis Watershed

HUC Level and Name	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
6. Grapevine Creek-Tuolumne River	2.63	2.46	2.34	2.27	2.24	2.12	1.99	1.80	1.64	1.59
6. Jawbone Creek-Tuolumne River	13.41[1]	12.52[1]	12.43[1]	10.92	9.40	8.49	7.29	5.32	3.48	2.69
7. Corral Creek	22.37[1]	23.25[1]	25.02[1]	22.87[1]	19.81[1]	17.60[1]	15.21[1]	10.45	5.93	4.02
7. Lower Jawbone Creek	10.65	9.96	11.30	10.63	9.52	8.65	7.71	5.55	3.68	2.55
6. Lower North Fork Tuolumne River	3.19	2.94	2.79	2.60	2.36	2.19	2.02	1.84	1.71	1.69
6. Lower Clavey River	8.46	8.17	7.67	6.79	6.20	5.68	4.84	3.91	3.04	2.48
7. Bear Springs Creek	12.23[1]	12.37[1]	11.86	10.99	10.08	9.44	8.36	7.41	6.69	1.95
6. Middle Clavey River	5.29	4.95	5.30	5.56	4.90	4.32	3.75	3.20	2.71	2.31
6. Reed Creek	8.12	7.75	7.25	6.48	5.46	5.06	4.34	3.54	3.00	2.63
7. Lower Reed Creek	14.55[1]	13.74[1]	12.33[1]	10.24	8.26	8.00	6.79	5.36	4.64	4.15
6. Lower Cherry Creek	7.71	6.92	6.37	5.43	4.50	4.66	4.19	3.35	2.57	2.25
7. Granite Creek	18.85[1]	17.20[1]	16.99[1]	14.93[1]	12.49[1]	11.20	9.58	6.51	4.11	3.37
6. Miguel Creek-Eleanor Creek	1.25	1.03	0.80	0.55	0.31	0.34	0.30	0.27	0.23	0.21
6. Poopenaut Valley-Tuolumne River	2.04	1.77	1.49	1.16	0.81	0.74	0.62	0.52	0.46	0.43
6. Lower Middle Fork Tuolumne River	13.78[1]	13.57[1]	13.74[1]	13.48[1]	12.40[1]	11.57	9.60	7.63	5.59	4.02
6. Upper Middle Fork Tuolumne River	1.76	1.40	1.03	0.66	0.28	0.26	0.22	0.18	0.15	0.14
6. Lower South Fork Tuolumne River	8.47	8.04	7.84	7.28	7.22	6.98	6.14	5.29	4.69	3.75
6. Upper South Fork Tuolumne River	1.54	1.35	1.15	0.98	0.82	0.78	0.75	0.72	0.69	0.66

[1] Denotes watersheds over the TOC

Grazing

Same as Alternative 1.

Alternative 4

Under Alternative 4, considerably fewer planted acres and trees are proposed in comparison with Alternative 1. Alternative 4 would reforest no more than 20% of each unit proposed in Alternative 1. Site preparation treatments would be the same as in Alternative 1, but on only 2,867 acres. Alternative 4 includes similar noxious weed eradication as Alternative 3 on 3,131 acres.

DIRECT AND INDIRECT EFFECTS

The direct and indirect effects of Alternative 4 are the same as those for Alternative 1 with the exception of those described below.

Erosion and Sedimentation

Ground disturbance from mechanized equipment would be reduced dramatically under Alternative 4 due to the reduction of treated areas in comparison to Alternative 1. Thousands of acres would not have initial mechanical site preparation treatments which would result in increased fuel loading. Alternative 4 proposes the reintroduction of early and frequent use of prescribed fire within the stands. Increased erosion following fire is related to the amount of vegetation removed. Prescribed burns, by design, do not consume extensive areas of organic matter (Baker 1990). Therefore, prescribed fires would have little impact on erosion and sedimentation, whereas intense wildfires may have substantial impacts (Brooks et al. 1997). Reducing fuel loading through site preparation and thinning followed by maintenance with prescribed fire has less potential for erosion and sedimentation than allowing fuel loading to increase as snags fall and having another large stand-replacing wildfire in the future. Although BMPs are expected to protect stream channels and water quality from treatment actions, there would be less overall impact with fewer treated acres.

The effects described for the use of aminopyralid, clopyralid, and clethodim for noxious weed eradication do not apply to Alternative 4. Instead the effects of manual noxious weed eradication are the same as Alternative 3.

The effects of glyphosate for site preparation and release of planted seedlings on 2,867 acres are similar to those described under Alternative 1, but on fewer acres.

Mechanized Equipment Activities

Table 3.15-11 describes mechanical activity acres (feller buncher and mastication) within 100 feet of perennial or intermittent streams and special aquatic features (SAFs) by soil burn severity. No machine pilling treatments falls within the 100 feet buffer of any hydrological feature. Under Alternative 4, no deep tilling and forest cultivation is proposed for site preparation purposes on any of the units. The potential to create more effective sediment trasnport networks to stream channels is reduced dramatically under Alternative 4. Table 3.15-11 shows that almost all of the watersheds have zero mechanical treatment acres within the high soil burn severity areas with the exception of the Lower Cherry Creek and Granite Creek watersheds having 6 and 2 acres respectively. This is a reduction of mechanical activities on 91% and 96%, respectively, of these two watersheds' acres when compared to Alternative 1.

Table 3.15-11 Alternative 4: Mechanical Activities by Soil Burn Severity

HUC Level and Name	SBS HIGH	SBS MOD	SBS LOW
6. Grapevine Creek-Tuolumne River	0	13	44
6. Jawbone Creek-Tuolumne River	0	16	82
7. Corral Creek	0	0	1
7. Lower Jawbone Creek	0	0	1
6. Lower North Fork Tuolumne River	0	8	12
6. Lower Clavey River	0	16	29
7. Bear Springs Creek	0	0	1
6. Middle Clavey River	0	6	4
6. Reed Creek	0	9	11
7. Lower Reed Creek	0	7	6
6. Lower Cherry Creek	6	59	39
7. Granite Creek	2	22	2
6. Miguel Creek-Eleanor Creek	0	0	0
6. Poopenaut Valley-Tuolumne River	0	0	0
6. Lower Middle Fork Tuolumne River	0	5	10
6. Upper Middle Fork Tuolumne River	0	0	0
6. Lower South Fork Tuolumne River	0	7	14
6. Upper South Fork Tuolumne River	0	0	3

LOW=Low and Unburned; MOD=Moderate; SBS=Soil Burn Severity (percent of Fire area)

CUMULATIVE EFFECTS

Equivalent Roaded Acres (ERAs)

ERAs were calculated for 13 HUC 6 and 5 HUC 7 watersheds. Table 3.15-12 shows the ERA values for Alternative 4.

Table 3.15-12 Alternative 4: Annual Percent ERA for HUC 6 and HUC 7 Analysis Watershed

HUC Level and Name	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
6. Grapevine Creek-Tuolumne River	2.63	2.46	2.34	2.27	2.20	1.95	1.76	1.58	1.42	1.38
6. Jawbone Creek-Tuolumne River	13.25[1]	11.57	10.02	8.12	6.40	5.53	4.40	3.26	2.28	1.88
7. Corral Creek	22.05[1]	19.90[1]	17.74[1]	14.29[1]	10.89	9.07	7.37	5.45	3.48	2.59
7. Lower Jawbone Creek	10.66	9.21	8.18	6.87	5.51	4.75	3.92	3.16	2.55	1.84
6. Lower North Fork Tuolumne River	3.19	2.94	2.79	2.60	2.35	2.15	1.96	1.78	1.65	1.63
6. Lower Clavey River	8.30	7.70	7.10	6.11	5.35	4.41	3.61	2.85	2.08	1.63
7. Bear Springs Creek	11.84	11.20	10.41	9.35	8.46	7.77	7.14	6.60	6.09	1.51
6. Middle Clavey River	5.29	4.87	5.21	5.46	4.78	4.20	3.62	3.06	2.53	2.13
6. Reed Creek	8.09	7.34	6.67	5.89	4.87	4.28	3.60	2.92	2.33	1.95
7. Lower Reed Creek	14.46[1]	12.39[1]	10.41	8.32	6.32	5.48	4.43	3.38	2.62	2.18
6. Lower Cherry Creek	7.71	6.71	5.67	4.60	3.62	3.47	2.82	2.21	1.69	1.50
7. Granite Creek	18.88[1]	15.95[1]	13.08[1]	10.24	7.59	6.48	5.07	3.76	2.86	2.62
6. Miguel Creek-Eleanor Creek	1.25	1.03	0.80	0.55	0.31	0.28	0.24	0.21	0.17	0.15
6. Poopenaut Valley-Tuolumne River	1.92	1.62	1.30	0.96	0.63	0.57	0.52	0.47	0.43	0.41
6. Lower Middle Fork Tuolumne River	12.58[1]	11.60	10.42	8.92	7.66	6.43	5.32	4.17	3.09	2.39
6. Upper Middle Fork Tuolumne River	1.73	1.35	0.98	0.60	0.23	0.20	0.17	0.15	0.13	0.11
6. Lower South Fork Tuolumne River	8.39	7.81	7.28	6.36	5.59	4.88	4.16	3.46	2.75	2.28
6. Upper South Fork Tuolumne River	1.53	1.33	1.13	0.96	0.79	0.74	0.71	0.67	0.64	0.62

HUC 6 and 7 Watersheds

ERA values for 6 of the 13 HUC 6 watersheds were equal or slightly lower for Alternative 4 than Alternative 1. These are Grapevine Creek-Tuolumne River, Lower North Fork-Tuolumne River, Middle Clavey River, Miguel Creek-Eleanor Creek, Upper Middle Fork-Tuolumne River, and Upper South Fork-Tuolumne River watersheds. The remaining 12 HUC 6 and HUC 7 watersheds had lower ERA values than Alternative 1. The largest decrease would occur in 2018 with up to a 5.27% decrease in ERA in the Corral Creek watershed under Alternative 4. ERA decreases were attributed primarily due to the large reduction of treated areas under Alternative 4. The contribution on ERAs under Alternative 4 is very small ranging from 0 to 0.75%. Less disturbance is beneficial to watersheds. However, the post-fire response would still dominate at all scales (project area, HUC 7, and HUC 6).

Although there are differences in ERA values between Alternative 1 and Alternative 4, the watersheds that exceeded the TOC were the same with the exception of Bear Springs Creek that fell back below TOC in year 2016. Therefore, cumulative effects for Alternative 4 are anticipated to be slightly less than Alternative 1 and Alternative 3.

Grazing

Same as Alternative 1.

Alternative 5

Alternative 5 is the same as Alternative 1 except for the deletion of prescribed fire in new plantations and it includes thinning at age 7 to create the desired ICO and fuel structure. This PCT would be accomplished using hand cutting, piling and burning treatments or lop and scatter if fuels are not an issue.

DIRECT AND INDIRECT EFFECTS

Same as Alternative 1.

CUMULATIVE EFFECTS

Equivalent Roaded Acres (ERAs)

ERAs were calculated for 13 HUC 6 and 5 HUC 7 watersheds. Results of these analyses were similar to that found under Alternative 1. Table 3.15-13 shows the ERA values for Alternative 5.

Table 3.15-13 Alternative 5: Annual Percent ERA for HUC 6 and HUC 7 Analysis Watershed

HUC Level and Name	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
6. Grapevine Creek-Tuolumne River	2.63	2.46	2.34	2.27	2.24	2.02	1.84	1.63	1.48	1.42
6. Jawbone Creek-Tuolumne River	13.41[1]	12.32[1]	11.38	9.44	7.53	6.62	5.32	4.08	2.87	2.36
7. Corral Creek	22.37[1]	23.03[1]	23.01[1]	19.36[1]	15.27[1]	12.99[1]	10.63	8.27	5.61	4.19
7. Lower Jawbone Creek	10.65	9.35	8.64	7.43	5.83	5.14	4.20	3.52	2.78	1.96
6. Lower North Fork Tuolumne River	3.19	2.94	2.79	2.60	2.36	2.17	1.98	1.79	1.66	1.64
6. Lower Clavey River	8.41	7.92	7.26	6.15	5.52	4.73	3.93	2.97	2.17	1.79
7. Bear Springs Creek	12.09[1]	11.76	10.93	9.76	8.86	8.12	7.48	6.82	6.25	1.72
6. Middle Clavey River	5.29	4.88	5.22	5.47	4.78	4.20	3.63	3.08	2.55	2.16
6. Reed Creek	8.12	7.51	6.90	6.06	5.07	4.52	3.95	3.23	2.56	2.26
7. Lower Reed Creek	14.55[1]	12.95[1]	11.17	8.88	6.99	6.25	5.54	4.35	3.33	3.12
6. Lower Cherry Creek	7.71	6.79	6.09	5.05	4.00	4.05	3.35	2.71	2.08	1.82
7. Granite Creek	18.85[1]	16.45[1]	15.40[1]	12.72[1]	9.66	8.45	6.71	5.30	4.04	3.48
6. Miguel Creek-Eleanor Creek	1.25	1.03	0.80	0.55	0.31	0.29	0.25	0.22	0.18	0.16
6. Poopenaut Valley-Tuolumne River	2.04	1.73	1.40	1.05	0.70	0.63	0.57	0.51	0.46	0.43
6. Lower Middle Fork Tuolumne River	13.23[1]	12.47[1]	11.67	10.68	9.29	7.95	6.72	5.27	4.08	3.17
6. Upper Middle Fork Tuolumne River	1.76	1.38	1.01	0.63	0.25	0.22	0.19	0.16	0.14	0.12
6. Lower South Fork Tuolumne River	8.40	7.84	7.47	6.72	6.13	5.40	4.62	3.84	3.14	2.69
6. Upper South Fork Tuolumne River	1.54	1.35	1.15	0.97	0.81	0.76	0.73	0.69	0.66	0.64

[1] Denotes watersheds over the TOC

Grazing

Same as Alternative 1.

Summary of Effects Analysis across All Alternatives

Beneficial Uses of Water

All alternatives are expected to result in maintenance of the applicable beneficial uses of water in the Water Quality Control Plan (Basin Plan) for the California Central Valley Water Quality Control Board (CVRWQCB 2011). Water temperature, sediment, and water quality following herbicide use are not expected to be adversely altered. Domestic and municipal water supplies and power are not adversely affected by the proposed action or alternatives. Recreational contact and non-contact waters are suitable for human use. Warm and cold freshwater habitat and wildlife habitat are not adversely affected by the proposed action or alternatives.

Erosion and Sedimentation

Under Alternatives 1, 3, and 5 sedimentation increases, due to mechanical activities, are anticipated to be highest in 2 HUC 6 and 2 HUC 7 watersheds with treatments proposed within 100 feet of streams in high soil burn severity areas (Jawbone Creek-Tuolumne River, Corral Creek, Lower Cherry Creek, and Granite Creek). Of the piling and burning activities, dozer piling has the highest potential for sedimentation and could occur in any of the treatment units. Under this project, the management requirement is to maintain a minimum of 60% well distributed ground cover within the 100 feet and to exclude dozer operations within 50 feet of a perennial stream, intermittent stream, or SAF. Although it is anticipated that some sediment could reach streams as a result of machine piling, streamside buffers, needle cast and/or resprouting vegetation should minimize this. Although minimal road work is proposed (just associated with thinning of the existing plantations), some erosion and sedimentation is anticipated along maintained and reconstructed roads. Implementation of BMPs and management requirements are expected to minimize these effects. Road reconstruction and maintenance may reduce erosion and sedimentation that is currently occurring as these treatments would involve improving road drainage features.

Under Alternative 2, new sediment transport networks would not be created. However, reductions in soil compaction on existing skid trails would also not occur. With no piling and burning, no risk of erosion and sedimentation would occur. Road reconstruction and maintenance would not occur, so hydrologic connectivity of roads and streams currently occurring would remain.

Under Alternative 4, ground disturbance from mechanized equipment would be reduced dramatically in comparison to Alternative 1, due to the reduction of treated areas and no deep tilling and forest cultivation for site preparation. No machine piling treatment falls within the 100 feet buffer of any hydrological feature. Effective sediment trasnport networks to stream channels is reduced dramatically under Alternative 4.

In summary, the Rim Reforestation project will not cause significant impacts to water resources. In the short-term project work would involve negligible and very localized soil disturbance due to planting and the release of young conifers. In the long-term (decades) the project would accelerate a return to conifer forest, stabilizing soils and improving water quality.

Fuel Loading

Alternatives 1, 3 and 5 site preparation activities would reduce fuel loading to 20 tons per acre of surface fuels, allowing for direct attack of future wildfires and maintenance of reduced fuel loading with prescribed fire.

Under Alternative 4, thousands of acres proposed in Alternative 1 would not have initial mechanical site preparation which could result in a higher risk of increased fuel loading through time. Alternative 4 proposes the reintroduction of early and frequent use of prescribed fire within the stands. Reducing fuel loading through site preparation and thinning followed by maintenance with prescribed fire has less potential for erosion and sedimentation than allowing fuel loading to increase as snags fall and having another large stand-replacing wildfire in the future.

Under Alternative 2, fuel loading is expected to increase over time. This would not allow for direct attack of wildfires or use of prescribed fire. A future reburn under higher fuel loadings would likely lead to soil erosion and sedimentation more severely than that caused by the reduction of fuel loading during site preparation activities under the action alternatives and maintaining these reduced loadings in the future by utilizing prescribed fire.

Riparian Vegetation

Under Alternatives 1, 3, 4 and 5, thinning of trees in riparian areas (where prescribed) may provide slight increases in sunlight, benefitting regrowth of riparian obligate trees and shrubs. Management requirements would prevent disturbance to riparian vegetation and the numerous meadows.

Under Alternative 2, no thinning of trees would occur, so no beneficial increase in sunlight would occur. There would be no disturbance to riparian vegetation.

Stream Condition

Under the action alternatives, measurable changes in stream flow or channel incision are not anticipated. BMPs and management requirements under all alternatives would involve maintaining ground cover and minimizing compaction. Therefore, measurable changes in stream flow are not anticipated to change beyond what already occurred as a result of the fire.

Under Alternative 2, no changes in stream flow or channel incision are anticipated. The erosion rates will continue decreasing as a result of additional needle cast and growth of live cover. Over time, trees falling would increase ground cover in many areas. Live vegetative recovery would increase over time under the no action alternative. This recovery is anticipated to be faster than under the action alternatives because disturbance by heavy equipment would not occur. Groundcover would recover the most slowly in High SBS areas, with erosion the most likely in these areas. The burned riparian areas would be left to recover naturally. Alternative 2 does not serve to improve the long-term watershed and riparian stability and function by enhancing and restoring the species diversity and structural composition of the forest surrounding riparian communities. Alternative 2 does not serve to restore or improve riparian RCA functions as a filtering or shading mechanism.

Water Quality

Under the action alternatives, water temperature is not expected to be affected. Under Alternatives 1, 3 and 5, some sedimentation would likely occur, particularly in areas having high soil burn severity adjacent to streams. That sedimentation potential would be reduced dramatically under Alternative 4. The potential for herbicides to contaminate surface water under Alternatives 1, 4 and 5 is limited. Herbicides are not proposed in Alternative 3. Adverse effects to beneficial uses of water are not anticipated.

Under Alternative 2, no changes to water temperature, stream sedimentation or water quality related to herbicide applications are anticipated. Adverse effects to beneficial uses are not anticipated.

3.16 WILDLIFE

Analysis Framework: Statute, Regulation, Forest Plan and Other Direction

The Endangered Species Act of 1973 (16 USC 1531 et seq.) requires that any action authorized by a federal agency not be likely to jeopardize the continued existence of a TE species, or result in the destruction or adverse modification of habitat of such species that is determined to be critical. Section 7 of the ESA, as amended, requires the responsible federal agency to consult the United States Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service concerning TE species under their jurisdiction. It is Forest Service policy to analyze impacts to TE species to ensure management activities are not be likely to jeopardize the continued existence of a TE species, or result in the destruction or adverse modification of habitat of such species that is determined to be critical. This assessment is documented in a Biological Assessment (BA) and is summarized and referenced in this Chapter.

USDA Departmental Regulation 9500-004 provides the following direction to USDA agencies.

Regional Forester Sensitive Species

1. Assure that the values of fish and wildlife are recognized, and that their habitats, both terrestrial and aquatic, including wetlands, are recognized and enhanced where possible as the Department carries out its overall missions.
2. Consider fish and wildlife and their habitats in developing programs for these lands. Alternatives that maintain or enhance fish and wildlife habitat should be promoted. When compatible with objectives for the area, management alternatives that improve habitat will be selected.
3. Balance the competing uses for habitat supporting fish and wildlife through strong, clear policies, relevant programs, and effective actions to sustain and enhance fish and wildlife in desired locations and numbers.
4. Recognize that fish and wildlife have inherent values as components and indicators of healthy ecosystems, and that they often demonstrate how altered environments may affect changes in quality of life for humans.
5. Avoid actions “which may cause a species to become threatened or endangered”.

Threatened, Endangered, Candidate and Proposed Species

1. Conduct activities and programs “to assist in the identification and recovery of threatened and endangered plant and animal species.”
2. Avoid actions “which may cause a species to become threatened or endangered.”
3. Consult “as necessary with the Departments of the Interior and/or Commerce on activities that may affect threatened and endangered species.”
4. Not “approve, fund or take any action that is likely to jeopardize the continued existence of threatened and endangered species or destroy any habitat necessary for their conservation unless exemption is granted pursuant to subsection 7(h) of the Endangered Species Act of 1973, as amended.”

Threatened and Endangered species are those Federally listed by the USFWS; Candidate species are candidates to become Proposed species but issuance of a proposed rule is currently precluded by higher priority listing actions (USFWS 1998). Sensitive species are those designated by the Regional Forester with the goal of proactively developing and implementing management practices to ensure that those species do not become Threatened or Endangered, and therefore require protection under the Endangered Species Act because of Forest Service actions (Departmental Regulation 9500-004).

The Forest Plan Compliance (project record) document identifies the Forest Plan Standards and Guidelines that specifically apply to this project and related information about compliance with the Forest Plan.

Other species of particular conservation concern were also identified during the planning process for this project, mule deer and black-backed woodpeckers, and they are also analyzed in this document.

Table 3.16-1 shows the wildlife species considered for this project. The Wildlife BE provides the rationale for why a species is not addressed in this Chapter.

Table 3.16-1 Endangered, Threatened, Candidate, Sensitive and Species of Conservation Concern

Common Name	Scientific Name	Type	Status[1]
Valley Elderberry Longhorn Beetle	*Desmocerus californicus dimorphus*	Invertebrate	T
Bald Eagle	*Haliaeetus leucocephalus*	Bird	S
California Spotted Owl	*Strix occidentalis occidentalis*	Bird	S, MIS
Great Gray Owl	*Strix nebulosa*	Bird	S
Northern Goshawk	*Accipiter gentilis*	Bird	S
Willow Flycatcher[2]	*Empidonax traillii*	Bird	S
Pacific Marten	*Martes caurina*	Mammal	S, MIS
Fisher	*Pekania pennanti (*formerly *Martes pennanti pacifica)*	Mammal	S
California Wolverine[2]	*Gulo gulo luteus*	Mammal	S
Sierra Nevada Red Fox[2]	*Vulpes vulpes necator*	Mammal	S
Fringed Myotis	*Myotis thysanodes*	Mammal	S
Pallid Bat	*Antrozous pallidus*	Mammal	S
Townsend's Big-Eared Bat	*Corynorhinus townsendii*	Mammal	S
Western Bumble Bee	*Bombus occidentalis*	Invertebrate	S
Black-Backed Woodpecker	*Picoides arcticus*	Bird	MIS, SCC
Mule Deer	*Odocoileus hemionus*	Mammal	MIS, SCC

[1] T=Threatened, C=Candidate, S=Sensitive, SCC=Species of Conservation Concern, MIS=Management Indicator Species.
[2.] Species not analyzed in detail.

Effects Analysis Methodology

Assumptions Specific to Wildlife

While some of these assumptions may be debatable, the comparison of alternatives using these assumptions is valid because the same assumptions are applied to all alternatives.

- All standards and guidelines, standard operating procedures, project design features, management requirements and mitigations would be fully adhered to and implemented.
- Implementation of project activities would generally occur in the following timeframes: fuels treatments (initial site preparation), reforestation and release treatments and prescribed burning 2017 to 2029.
- For the snag retention management requirement in Old Forest Emphasis Area (OFEA) and Home Range Core Area (HRCA) units, the intent is to retain legacy structure where it exists for long-term resource recovery needs (i.e. the development of future old forest habitat with higher than average levels of large conifer snags and down woody material). Retention of all hardwood snags outside Strategic Fire Management Areas and up to six hardwood snags inside Strategic Fire Management Areas greater than or equal to 12 inches dbh. This requirement applies to all action Alternatives.

- Unit boundaries were developed using GIS data at various scales. The level of inaccuracy of a line on a map at most scales used was approximately 20 feet. When utilizing these data on the ground, some variation in unit boundaries may occur. The scope of these variations was considered in the effects analysis.
- Suitable habitat acres were generated using ArcGIS and several data sources. At the scale of this analysis, up to 257,000 acres, rounding errors are likely to cause slight variation in acres when presented under different species sections. These slight variations are considered minimal and have no measureable effect on the accuracy of this analysis.
- All mechanical treatment methods and equipment used for project activities, as described in the EIS, would have similar impacts to wildlife resources.

Data Sources

- California Wildlife Habitat Relationships (CWHR).
- California Natural Diversity Database (CNDDB).
- Natural Resource Information System (NRIS Wildlife).
- Black-backed woodpecker occupancy model by Tingley et al. (2014a).
- GIS layers including: RAVG database, Worldview Imagery, Stanislaus vegetation database, land allocations, project unit boundaries and road treatments.
- Project survey reports and incidental detection records.
- Scientific literature, internal and draft reports.

Wildlife Indicators

Wildlife Indicators vary by species and are stated under the environmental consequences for each species.

Wildlife Methodology by Action

PROJECT ACTION AREA

Unless otherwise specified, the analysis area used to analyze the direct and indirect effects on wildlife and wildlife habitat is about 155,000 acres and includes Stanislaus NFS lands within the Rim Fire perimeter. The analysis area is based on: 1) Acres burned in a distinct geographic area and administrative setting that influences the purpose and need of proposed activities; 2) Area of impact to forest vegetation from the wildfire and subsequent proposed project activities; 3) Furthest measurable extent of changes to disturbance levels and habitat modification that would occur as a result of implementing any of the proposed alternatives; and, 4) Consistency with the analysis area described in the Rim Reforestation reports for fire and fuels, soils and vegetation because ecologically, the dynamics among these elements are inherently linked with terrestrial wildlife habitat. This analysis is bounded in time for short-term effects (up to 20 years) and long-term effects (up to 80 years). Eighty years was chosen for the long-term analysis because that is when the modeling shows forested habitat reaching moderate to high capability for the majority of species considered in this report. This timeframe is used to serve for relative analysis comparisons between the alternatives.

CUMULATIVE EFFECTS

According to CEQ NEPA regulations, “cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions (40 CFR 1508.7).

The analysis area used to analyze the cumulative effects on wildlife and wildlife habitat is about 257,000 acres and includes all lands within the Rim Fire perimeter. The analysis area is based on: 1) Treatments are proposed in and would modify burned areas within the Rim Fire area only; 2) This area provides an appropriate context for the reasonable determination of effects to species considered and their habitat; and 3) Relevant cumulative effects, particularly other projects that have or will treat areas within the fire perimeter, can be effectively and meaningfully addressed. This analysis is bounded in time for short-term effects (up to 20 years) and long-term effects (up to 80 years). This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that affected the environment and might contribute to cumulative effects, including treated acres under the Rim Recovery project. All activities listed and described in Appendix B are not expected to affect all species considered in this document. See individual species analysis sections for further discussion of relevant present and reasonably foreseeable future actions.

Terrestrial Wildlife: Herbicide Risk Assessment (toxicological effects)

Under Alternatives 1 and 5, an Integrated Pest Management (IPM) approach is proposed for weed eradication, which includes the use of herbicides. Herbicide use is also proposed in reforestation units for site preparation and release. Under Alternative 4, herbicides are proposed for reforestation areas only, not weed eradication (2.02 Alternatives Considered in Detail). This analysis covers the worst case scenario, or application of herbicides on the maximum number of acres. While spraying every acre is unlikely and would vary across the project area depending on vegetation composition and response, this analysis will inform the reader of the maximum effects possible to terrestrial wildlife. Under Alternatives 1 and 5, four herbicides are proposed for use to control noxious weeds and reduce competing vegetation for newly planted conifers. Most treatment areas for weeds and conifer planting overlap, thus acres may be double counted in some instances. The herbicides proposed for use under Alternatives 1 and 5 are glyphosate, clopyralid, clethodim and aminopyralid. The herbicide proposed for use under Alternative 4 is glyphosate. Herbicides would be applied using low pressure backpack sprayers with a psi of about 15.

Reforestation

Under Alternatives 1 and 5, up to about 26,000 acres would be sprayed with glyphosate for either site preparation or release treatments (2.02 Alternatives Considered in Detail). It is important to note that not every part of any given acre would actually be sprayed. Several management requirements and topographical constraints would reduce the amount of acres sprayed including; oak buffers, sensitive plant and cultural sites, retention of up to 20% vegetation on an acre before spraying would be triggered and inoperable areas. Treatments would be spread across the project area, with different units being treated over multiple years. The treatments would be phased in; meaning only a portion of the total acreage would be treated any given year. See Appendices N an R for the noxious weed and reforestation implementation schedules and associated acres. The maximum number of herbicide treatments would be three if deep tilling is used for site preparation and four if deep tilling is not used. The first year of spraying is considered the worst case scenario as subsequent years would likely require less intensive treatment based on the first year's application results.

Under Alternative 4, up to about 4,130 acres would be sprayed with glyphosate for either site preparation or release treatments (2.02 Alternatives Considered in Detail). Treatments would be spread across the project area, with different units being treated over a few years. See Appendix R for the implementation schedule and associated acres.

Noxious Weeds

The chemicals proposed for noxious weed treatments are glyphosate, clopyralid, aminopyralid and clethodim. Treatments would be conducted over multiple years, see Appendix N for the implementation schedule and associated acres. The first year of treatments is considered the worst case scenario and follow up treatments are expected to be less intensive as infestations are reduced.

The majority of the noxious weed treatments are within reforestation units. Under Alternative 4, no herbicides are proposed for noxious weed treatments.

Risk assessments were completed for all herbicides proposed for use in this project. The SERA risk assessments (SERA 2004, 2011, 2014) and associated worksheets are hereby incorporated by reference and provide more detailed discussion, assumptions and validation of this risk assessment. Risk assessments can be used to determine the ecological risk to individuals exposed to concentrations of chemicals in the open environment, aquatically or terrestrially. Exposure risk is, in part, determined by comparing estimates of expected environmental concentrations (EEC) derived from modeled outputs to toxicity values established for the species or a surrogate for the species of concern. These EECs for acute and chronic scenarios are then compared to available toxicity data for terrestrial species, producing a hazard quotient (HQ, HQ = EEC/toxicity). These models consider typical (center), low and high values for exposure and the resulting hazard quotient. The smaller the HQ, the lower the risk is to individuals. Conversely, as the HQ approaches or exceeds equity (i.e., a value of one (1)), there is a greater risk that there could be a toxicological effect to an individual. For acute and chronic exposures, the Forest Service has adopted a toxicity threshold of NOAEL (the no observable adverse effect level). NOAEL values are based on longer-term studies of organisms exposed to low concentrations of chemicals that are used to determine whether physiological or generational effects exist.

Chemical Descriptions

GLYPHOSATE

Glyphosate is a broad-spectrum foliar herbicide and could be used on several noxious weeds and competing vegetation types effectively. Glyphosate is relatively immobile in most soil environments as a result of its strong adsorption to soil particles with a low leaching potential. Glyphosate on vegetation has a half-life estimated at 10 days. Glyphosate is rapidly metabolized by an animal’s kidneys and excreted in waste products (SERA 2011). It is not known to bioaccumulate in animal fat or other body tissues; therefore, the risk to predators, such as fisher or spotted owls, of consuming herbivores is very low.

CLOPYRALID

Clopyralid is a selective herbicide used primarily in the control of broadleaf weeds, mainly thistles. It is most effectively used as a post emergent because it is rapidly absorbed across leaf surfaces. It does not bind tightly with soil and there is risk of leaching. However, this potential risk is reduced by the relatively rapid degradation of clopyralid in soil. The half- life of clopyralid on vegetation is about 8 days and in soil about 10 to 19 days (SERA 2004). Toxicity has been relatively well characterized in experimental animals, and some additional studies on birds, bees, spiders and earthworms generally support the characterization of clopyralid as relatively non-toxic. No adverse effects are anticipated or even considered plausible in terrestrial animals from the use of clopyralid at the typical application rate of 0.35 lb a.e. per acre (Ibid). It is important to note that the typical application rate is 0.10 lb ae. per acre higher than is proposed in this project.

AMINOPYRALID

Aminopyralid is a selective herbicide used primarily in the control of broadleaf weeds, mainly thistles SERA 2004). Information is limited regarding aminopyralid in open literature because it is a new herbicide. It is in the same class of herbicides as and on some occasions used as an alternative for clopyralid. It is most often applied to the vegetation as a post emergent. Aminopyralid on vegetation has a half-life estimated at 10 to 16 days (Ibid). There is no indication that mammals, birds, or terrestrial invertebrates would be adversely affected by aminopyralid (Ibid).

CLETHODIM

Clethodim is a selective post-emergence herbicide used for the control of annual or perennial grass weeds, such as medusahead and barbed goatgrass (SERA 2014). Risks to mammals can be well characterized, but it is more difficult to characterize risks to other groups of terrestrial animals because of limitations in the available data on birds and terrestrial insects (Ibid). Serious effects to mammals do not seem likely and the potential for direct effects to birds associated with acute exposures appears to be low. Limitations with the risk assessment on clethodim involves the small number of species on which toxicity data are available relative to the large number of species that may be exposed. This limitation is exacerbated by the lack of field studies relevant to the assessment of the effects of clethodim applications on most groups of non-target species.

Based on acute toxicity, US EPA/OPP classify clethodim as practically non-toxic to mammals, birds and honeybees. Field studies to investigate the impact of clethodim on mammalian wildlife were not found in the literature; however, body weight loss or decreased body weight gain is the most consistent effect observed in experimental mammals exposed to clethodim in acute, sub chronic and chronic studies (Ibid). In one reproductive study in quail, clethodim did not have an impact on the body weights of adults or offspring. Based on the LC_{50} of >100 µg/bee (Lethal Concentration when 50% of the test population is killed) for technical grade clethodim, US EPA/OPP/EFED classifies clethodim as practically nontoxic to honeybees and is considered a functional NOAEL (Ibid).

Surrogate Species

Toxicological effects studies of herbicide use on wild animals are almost non-existent. Specifically, TES species are not tested directly, thus the need for surrogate species to represent others for herbicide risk assessments and the application of chemicals. It is important to note a surrogate species may not accurately represent the species of concern, thus caution should be applied to the results of ecological risk assessments and the use of surrogate species. A large number of tests have been conducted using more readily available animals exposed to chemicals using standardized methods, which serve as surrogate species. Some surrogate species included in the risk assessment scenarios include honey bees, goats, rats, rabbits and bobwhite quail.

Types of Exposure

Herbicides have the potential to directly and indirectly affect terrestrial wildlife species and habitats through exposure and contamination resulting from direct spraying of an individual, ingestion of contaminated media (e.g., vegetation, prey species or water), grooming activities or indirect contact with contaminated vegetation (SERA 2004, 2011, 2014). Direct and indirect effects to individuals in either aquatic or terrestrial habitats are dependent upon the toxicity of the chemicals being used, the exposure levels to which the individuals are likely to be subjected and the likelihood that an individual would be exposed to the chemicals. Further, to fully evaluate the risk and potential effects, the dose and exposure information (toxicity and EEC values, respectively) must be related to the life history characteristics of the animal to estimate the likelihood that an animal would be exposed to the chemicals.

Complete exposure assessments, toxicity values, toxicological thresholds and hazard quotients for all chemicals proposed in this project are available in the project record and are hereby incorporated by reference. Summary tables for scenarios considered in this assessment are provided for easy reference.

For this assessment, the following species are considered: bald eagle, black-backed woodpecker, California spotted owl, great gray owl, fringed myotis, pallid bat, Townsend’s big-eared bat, fisher, marten, mule deer and western bumblebee. Because we would employ a 100 foot buffer with no herbicide application around any elderberry shrub, no toxicological effects to VELB or elderberry shrubs from herbicide application are expected; therefore, no further analysis is warranted.

Scenarios

The following species life histories, existing habitat conditions, and likely types of exposure were used to choose appropriate scenarios considered in this analysis for glyphosate, clopyralid, aminopyralid and clethodim. All scenarios were considered and analyzed under all chemicals unless noted otherwise.

FISHER AND MARTEN

Fisher and marten are wide ranging meso-carnivores with large home ranges and a preference for late seral forested habitats. Fishers have been documented to move up to 3 miles per day and are active day or night. Marten exhibit similar habits, traveling long distances and being active day or night. They forage opportunistically on a diet that varies both seasonally and geographically which includes small mammals, birds, insects, fruits, berries, fungi and reptiles. Fisher and marten are uncommon and sensitive to human disturbance. Neither species has been documented in the project area.

The areas proposed for herbicide treatments include potential foraging and dispersal habitat for marten and fisher.

Reforestation

After the initial herbicide treatment, understory vegetation is expected to be much reduced, thus these areas would be of much less utility as foraging habitat because prey such as small mammals and birds rely on understory vegetation for cover and food. It is plausible that the remaining root systems of treated shrubs would still provide subnivean habitat for mice or ground squirrels; however, the temperature regime just below the surface would be changed because of the reduction of foliar cover above ground and may become unsuitable for animals using the upper soil profile for burrows. It is likely that any individual fisher or marten in this area would be traveling in adjacent green forest not proposed for treatments in this project. Because of their avoidance of open areas, it is unlikely that they would spend much time in the affected area, especially after the first year of treatment other than to inspect the now readily visible burrow holes or pockets of untreated vegetation within treated units.

Weeds

Chemicals would be applied to each specific weed type, not broadcast sprayed, so the number of non-targeted plants being killed would be minimal.

The likely types of exposure considered in this assessment for marten and fisher would be ingestion of contaminated prey (small mammals), fruit or contaminated water (non-accidental acute and chronic). Because of their sensitivity to disturbance and human presence, any individuals in the treatment area would likely be flushed and displaced during implementation. Thus, the scenario describing direct spraying of an individual is discountable and is not evaluated in this assessment.

MULE DEER

Mule deer are wide ranging herbivores that utilize a variety of vegetation types including oak woodlands, coniferous forest, meadows and grasslands, chaparral and riparian corridors. They browse or graze, showing preferences for forbs and grasses, as well as tender new shoots of various shrub species including mazanita, ceanothus, mountain mahogany and bitterbrush.

Reforestation and Weeds

The areas proposed for herbicide treatments include suitable transition and concentration habitat, as well as critical winter range. The most likely exposure for deer is when foraging during early spring and summer, which would encompass critical winter range and migratory or transition range. The likely types of exposure considered in this analysis for mule deer would be ingestion of contaminated fruit, vegetation and water. Because of their sensitivity to disturbance and human presence, any individuals in the treatment area would likely be flushed and displaced during implementation. Thus, the scenario describing direct spraying of an individual is discountable and is not evaluated in this assessment.

PALLID, BIG-EARED AND FRINGED MYOTIS BATS

Bats are found in various habitat types such as forests, woodlands, grasslands, meadows and riparian corridors. They roost in buildings, under bridges, in rock crevices, foliage and trees. Day roosts are usually enclosed locations such as rock crevices or hollowed out snags where they can remain undetected by potential predators. Most bats are sensitive to disturbance at roost sites. Bats can travel over a mile to favorite foraging locations. They forage at night exclusively on insects, using open habitats such as meadows, forest edges, or riparian corridors. See species account section in this document for more life history information for these species.

Reforestation and Weeds

The areas proposed for herbicide treatments include suitable foraging and travelling habitat for fringed myotis, pallid bats and big-eared bats. The most likely exposure for these species is during foraging bouts along forest edges or while traveling on their way to a suitable foraging location. Thus, the likely types of exposure considered in this assessment for bats would be ingestion of contaminated prey (insects) and ingestion of contaminated water (non-accidental-acute and chronic). Because they are nocturnal, foraging at night, the scenario describing direct spraying of an individual is discountable and is not evaluated in this assessment.

BALD EAGLE, GREAT GRAY OWL, GOSHAWK AND SPOTTED OWL

Great gray owls, goshawks and spotted owls are found in late seral forested habitats, great gray owls are closely associated with meadows. Bald eagles are closely associated with lake areas. Eagles rely on prey that are; dead, dying or otherwise vulnerable. They eat fish, rabbits, waterfowl, and mammals. Owls and goshawks are carnivorous predators that forage over large areas consuming prey items such as squirrels, small birds, woodrats, mice, gophers and voles. They typically hunt from perches and on the wing. All these species are sensitive to disturbance and human presence. Several great gray owl, spotted owl and goshawk territories exist throughout the project area and in close proximity to treatment units. One bald eagle breeding territory exists at Cherry Lake. See species account sections in this document for more life history information for these species.

Reforestation

The areas proposed for herbicide treatments include potential foraging habitat for bald eagles, great gray owls, goshawks and spotted owls. It is likely that any individual eagles, owls or goshawks near treatment areas would be utilizing adjacent green forest and edge habitat not proposed for treatments in this project.

Weeds

Chemicals would be applied to each specific weed type, not broadcast sprayed, so the number of non-targeted plants being killed would be minimal. The likely types of exposure considered in this assessment for bald eagles, owls and goshawks would be ingestion of contaminated prey (small mammals or fish) or contaminated water (non-accidental acute and chronic). Because these species are highly mobile and sensitive to human disturbance, the scenario describing direct spraying of an individual is discountable and is not evaluated in this assessment.

BLACK-BACKED WOODPECKERS

Black-backed woodpeckers are closely associated with burned forest, although they do use green forest as well. Black-backed woodpeckers readily forage on larvae of wood-boring beetles, engraver beetles, and mountain pine beetles found in the trunks of burned conifers (Dixon and Saab 2000). Very low numbers of black-backed woodpeckers have been documented in the project area. See species account section in this document for more life history information for this species.

Reforestation and Weeds

Snags in the proposed treatment areas would provide only small areas in which black-backed woodpeckers would forage. Individual woodpeckers would more likely utilize adjacent burned forest that was not salvage logged or snags in green forest. The likely types of exposure considered in this assessment for black-backed woodpeckers would be ingestion of contaminated prey (insects), fruit or water (non-accidental acute and chronic). Because these species are highly mobile, the scenario describing direct spraying of an individual is discountable and is not evaluated in this assessment.

The scenario representing the ingestion of contaminated insects is that of a bird eating insects that have just been sprayed with chemical. Individuals would be at greatest risk of being exposed if they were foraging through the area either immediately or within a few days after spraying occurred. Insects sought by black-backed woodpeckers reside under the bark and in the trunks of burned trees and are much less likely to be exposed because understory plants and weeds would be targeted, standing burned trees would not be sprayed.

The scenario representing the ingestion of contaminated fruit is a small bird or large bird consuming fruit that has been directly sprayed with chemical. The small bird used in this scenario weighs 0.1kg and the large bird weighs 4kg, neither of which is close to the weight of black-backed woodpeckers (0.07kg), thus both scenarios are shown which represent animals smaller and larger than the species of concern. This species are considered bounded by these scenarios. It is assumed that black-backed woodpeckers would fall somewhere between the values for the birds in these scenarios.

Exposure to contaminated water is modeled to estimate glyphosate concentrations in water using a Gleams-Driver model. This model estimates peak and longer-term pesticide concentrations in surface water. HQs for birds are derived when modeled concentration rates are combined with the bird’s weight and amount of water consumed. The small bird used in this scenario weighs 0.1kg and the large bird weighs 4kg, neither of which is close to the weight of black-backed woodpeckers (0.07kg), thus both scenarios are shown which represent animals smaller and larger than the species of concern. This species are considered bounded by these scenarios. It is assumed that black-backed woodpeckers would fall somewhere between the values for the birds in these scenarios.

WESTERN BUMBLE BEE

No records exist of western bumble bee on the Stanislaus. Bumble bees forage, collecting nectar and pollen on many different flowering plants including; lupine, penstemon, asters, clovers, etc.

Reforestation

The areas proposed for herbicide treatments may provide suitable foraging, nesting and overwintering habitat to bumble bees. It is likely that after the first year of treatment, understory vegetation would be much reduced in treated areas and would be unsuitable for foraging. Untreated areas within and adjacent to treated areas would continue to provide suitable foraging habitat.

Weeds

Chemicals would be applied by targeting each plant, not broadcast spraying, so the number of non-targeted plants being sprayed would be minimal. The weeds would be sprayed prior to flowering, which reduces the potential for exposure to bees.

The likely types of exposure considered in this assessment for bumble bees would be the direct contact honeybee scenario and ingestion of contaminated vegetation.

The scenarios representing the ingestion of contaminated vegetation is an invertebrate consuming short grass or broadleaf vegetation that has been directly sprayed with chemical. This scenario is run for acute exposure, use residue rates, related to the amount of contaminated food eaten per day. The scenario for direct spray involves a honey bee that is directly sprayed with chemical and assumes complete absorption over the first day of exposure. This scenario is run for acute exposure only.

Glyphosate Analysis

Under Alternatives 1 and 5, up to about 26,000 acres are proposed for glyphosate treatments associated with reforestation and eradication of noxious weeds. Treatment areas are spread across the entire project area. Under Alternative 4, up to 4,145 acres are proposed for glyphosate treatments in reforestation areas only. Glyphosate would be applied via backpack sprayer in a broadcast manner. Reference Table 3.16-2 for all scenarios and associated HQ values cited below.

MAMMALS

Toxicity values for mammals are based on an NOAEL of 500 mg a.e./kg/bw/day for acute and chronic exposure scenarios (SERA 2011). Decreases in food consumption and reduced body weight gain are commonly observed in mammals exposed to glyphosate (Ibid). However, most field studies provide no suggestion of adverse effects on mammalian populations or reproductive capacity, other than secondary effects which can be attributed to changes in vegetation (Ibid). All but one of the HQs reported for glyphosate application under Alternatives 1, 4 and 5 are below the NOAEL or No Observable Adverse Effect Level for the mammals considered. The upper limit for bats consuming contaminated insects is 1.0, which is just at the threshold of NOAEL.

Fisher and Marten

For the scenario representing ingestion of a contaminated small mammal, a significant reduction in the risk of exposure is expected within a few days of the small mammal being sprayed. A small mammal, if sprayed, would be expected to immediately start grooming its fur, which is a normal behavioral response when foreign objects are introduced to its fur. Once ingested by the small mammal through grooming its fur, the chemical would be quickly metabolized and excreted by the kidneys in the animal’s waste products. Data from Brewster et al (1991) shows that after 28 hours, only 0.06% of an administered dose of 10 mg/kg bw remained in the blood of rats (SERA 2007).

All of the associated upper level (worst case scenario) HQ values for acute and chronic/longer-term exposure to glyphosate are well below 1, many are several orders of magnitude below the NOAEL threshold HQ value of one (1).

In summary, Alternatives 1, 4 and 5 have an extremely low potential for direct or indirect individual effects from the proposed application of glyphosate as described above. The proposed application of herbicides poses very limited toxicological risk to marten and fisher, especially considering they have not been documented in the project area. Because all HQs are well below the threshold of NOAEL an adequate margin of safety exists in the unlikely or limited exposure of fisher or marten to contaminated prey, fruit or water.

Mule Deer

Based on acute lethality data for glyphosate, there appear to be no remarkable differences in sensitivity among mammals; however, there is limited data that indicate larger mammals such as deer are somewhat more sensitive than smaller mammals to sub-lethal doses of glyphosate (SERA 2011).

It is possible that individual deer could forage on berries, leaves or grasses that have been sprayed. The associated HQ values for non-accidental acute exposure at the upper limit (worst case scenario) for ingestion of contaminated broadleaf, tall, and short grass are 0.5, 0.4 and 0.9 respectively, approaching the threshold value of one (1) and warrants further discussion. The scenario for consumption of contaminated short grass (HQ equals 0.9) is based on the large mammal eating 5 pounds of contaminated short grass per day. It is expected that the treated vegetation would quickly die becoming less desirable and the toxicity of the herbicide would result in taste aversion, resulting in reduced consumption of treated vegetation. It is unlikely that a deer would eat 5 pounds of contaminated short grass a day when untreated more palatable vegetation would be available near treated areas.

The associated HQ values for non-accidental acute and chronic/longer-term exposure at the upper limit (worst case scenario) for a large mammal ingesting contaminated water are several orders of magnitude less than the threshold value of 1.

In summary, Alternatives 1, 4 and 5 have limited potential for direct or indirect individual effects from the proposed application of glyphosate as described above. The proposed application of herbicides poses some toxicological risk to deer because of the amount of area to be treated over multiple years. However, it is important to note that the exposure based on this risk assessment shows that all HQs are below the threshold of NOAEL providing mule deer an adequate margin of safety in the event that they are exposed to contaminated vegetation or water.

Pallid, Big-Eared and Fringed Myotis Bats

The associated HQ value for non-accidental acute exposure at the upper limit (worst case scenario) for ingestion of contaminated insects is 1.0. This HQ value is at the threshold value of one (1) and warrants further discussion. This upper limit is based on the assumption that 100% of the insects being consumed have been contaminated and the amount of prey consumed accounts for about half of the body weight of the animal (0.02kg). The weight of the small mammal in this scenario a bit larger than the weight of a pallid bat, but 3 to 4 times that of the weight of fringed myotis and big-eared bats. Bats can eat up to their body weight in insects each night. Bats tend to follow “foraging routes” and may target several foraging areas in one night or feeding bout; therefore, the likelihood that an individual would consume half its body weight in contaminated insects at the spray location is low. It is more likely that they would receive a lesser exposure, perhaps better estimated by the central or lower limit exposure which has associated HQ values of 0.2 and 0.02 respectively, far below the threshold value of one (1). The duration for upper limit (worst case scenario) would last less than a few days in any one location. Insects would disperse from the immediate area naturally or as conditions such as the wind blew them elsewhere diluting the concentration of contaminated individuals available for consumption. The upper level model is an extremely conservative estimate based on the potential exposure of individual bats to contaminated insects and is at the threshold value of one (1) which indicates a slightly increased risk for toxic effects to individual bats.

The associated HQ values for non-accidental acute and chronic/longer-term exposure at the upper limit (worst case scenario) for a small mammal ingesting contaminated water are several orders of magnitude less than the threshold value of 1.

In summary, Alternatives 1, 4 and 5 have limited potential for direct or indirect individual effects from the proposed application of glyphosate as described above. The proposed application of herbicides poses some toxicological risk to bats because of the amount of area to be treated over multiple years. However, it is important to note that the exposure based on this risk assessment shows that all but one HQ are several orders of magnitude less than the NOAEL. The HQ value for ingestion of contaminated insects has an HQ value of 1, which just reaches the threshold. Therefore, these species are provided an adequate margin of safety in the event that they are exposed to contaminated prey or water.

BIRDS

Toxicity values for birds are based on an NOAEL of 1,500 or 58 mg a.e./kg/bw/day for acute and chronic exposure scenarios respectively (SERA 2011). As with mammals, decreases in food consumption and reduced body weight gain are commonly observed in birds exposed to glyphosate (Ibid). While no specific studies have been conducted on birds, two studies involving the immersion of eggs in a solution of Roundup suggest that it is not likely to cause developmental effects in birds. No field studies report adverse effects in birds and effects on bird populations appear to be secondary effects which can be attributed to changes in vegetation (Ibid). All but one Hazard Quotient reported for proposed glyphosate application under Alternatives 1, 4 and 5 are below the NOAEL for the birds considered. One HQ value related to the scenario of black-backed woodpeckers exposed to contaminated fruit was 1.7.

Bald Eagle, Great Gray Owl, Goshawk and Spotted Owl

For the scenario representing ingestion of a contaminated small mammal, a significant reduction in the risk of exposure is expected within a few days of the small mammal being sprayed. A small mammal, if sprayed, would be expected to immediately start grooming its fur, which is a normal behavioral response when foreign objects are introduced to its fur. Once ingested by the small mammal through grooming its fur, the chemical would be quickly metabolized and excreted by the kidneys in the animals' waste products. Data from Brewster et al (1991) shows that after 28 hours, only 0.06% of an administered dose of 10 mg/kg bw remained in the blood of rats.

All of the associated upper level (worst case scenario) HQ values for acute and chronic/longer-term exposure to glyphosate are several orders of magnitude below the NOAEL threshold value of one (1).

In summary, Alternatives 1, 4 and 5 have limited potential for direct or indirect individual effects from the proposed application of glyphosate as described above. The proposed application of herbicides poses some toxicological risk to bald eagles, great gray owls, goshawks and spotted owls, because of the amount of area to be treated over multiple years. However, it is important to note that the toxicity exposure scenarios analyzed in the risk assessment show that all HQs are several orders of magnitude less than the NOAEL; therefore, these species are provided an adequate margin of safety in the event that they are exposed to contaminated prey or water.

Black-backed Woodpecker

The associated HQ value for non-accidental acute exposure at the upper limit (worst case scenario) for ingestion of contaminated insects is 0.7. This HQ value is approaching the threshold value of one (1) and warrants further discussion. This upper limit is based on the assumption that 100% of the insects being consumed have been contaminated. Because the insects consumed by black-back woodpeckers are not typically associated with the target vegetation, it is highly unlikely that they would consume only contaminated insects. It is more likely that would receive a lesser exposure, perhaps better estimated by the central or lower limit exposure which has associated HQ values of 0.1 and 0.01 respectively, which are far below the threshold value of one (1).

The associated HQ values for non-accidental acute and chronic exposure at the upper limit (worst case scenario) for ingestion of contaminated fruit is 0.4 to 0.05 and 1.7 to 0.2. The HQ value for chronic exposure is greater than the threshold value of one (1) and warrants further discussion. Treatments would be applied during the early spring months before many plants have gone to fruit. It is expected that sprayed plants would be damaged or killed such that they would not produce fruit after treatment. Additionally, untreated areas would provide foraging opportunities to individuals adjacent to and in treated areas. However, the potential for increased exposure of black-backed woodpeckers to toxic chemicals occurs under this scenario.

The associated HQ values for non-accidental acute and chronic/longer-term exposure at the upper limit (worst case scenario) for a small or large bird ingesting contaminated water are several orders of magnitude less than the threshold value of 1.

In summary, Alternatives 1, 4 and 5 have moderate potential for direct or indirect individual effects from the proposed application of glyphosate as described above. The proposed application of glyphosate poses some toxicological risk to black-backed woodpeckers because of the amount of area to be treated over multiple years. However, it is important to note that the exposure based on the risk assessment shows that most HQs are less than NOAEL; therefore, these species are provided an adequate margin of safety in the event that they are exposed to contaminated prey, vegetation or water. There is a slightly elevated risk associated with exposure to contaminated fruit.

INVERTEBRATES

Toxicity values for insects are based on an NOAEL of 860 mg a.e./kg/bw/day for acute and chronic exposure scenarios respectively (SERA 2011). Hazard Quotients reported for proposed glyphosate application under Alternatives 1, 4 and 5 indicate a toxicological risk for invertebrates.

Western Bumble Bee

A study of the application of very high water volumes and surfactant concentrations to honeybees found lethal effects, but this was suspected to have been the result of drowning rather than toxicity of surfactants (Bakke 2003). Regardless, insects are sensitive to physical impacts of liquids, including drowning. Palmer and Krueger (2001a *in* SERA 2001) report mortality of 5% (3 of 60) of honeybees directly sprayed with a dose of 100 µg/bee. This type of exposure corresponds to an HQ of 2.0. This dose is classified as an NOEC (No Observable Effect Concentration) because it was not significantly different from mortality in the matched solvent control (SERA 2011). It was significant when combining the matched solvent (0 of 60) with the negative control (0 of 60) to reach a control of (0 of 120). The direct contact honeybee acute exposure was not included because contact toxicity data, nectar residue data and oral toxicity data is not available for honeybees.

The associated HQ values for acute exposure at the upper limit (worst case scenario) for ingestion of contaminated short grass and broadleaf vegetation are 3.0 and 1.7 respectively, above the threshold value of one (1) and warrants further discussion. Vegetation would be treated in the early spring before the flowering period for most plants and are expected to die back within a week or two. Because the sprayed plants are not likely to provide suitable forage for bumble bees, they would likely travel past treated areas. Untreated vegetation would be available within treatment units and adjacent to treated areas throughout implementation.

In summary, Alternatives 1, 4 and 5 have moderate potential for direct or indirect toxicological effects to individuals from the proposed application of glyphosate as described above. The proposed application of herbicides poses toxicological risk to bumble bees because of the amount of area to be treated over multiple years. Table 3.16-2 summarizes the HQs for the terrestrial wildlife species discussed above.

Clopyralid Analysis

Under Alternatives 1 and 5, about 705 acres are proposed for treatment of noxious weeds with clopyralid. These treatment areas are spread across 72,000 acres within the project area. Thistles, woolly mullein, spotted knapweed and tocalote would be the targeted species sprayed with Clopyralid. Clopyralid applications would target each individual plant, not broadcast sprayed, so the number of non-target plants sprayed is assumed to be very few. Spraying would occur in the early to mid-spring before most if not all target weeds and surrounding vegetation were flowering. There is limited potential for terrestrial animal exposure throughout the project area. Reference Table 3.16-3 for all scenarios and associated HQ values cited below.

ALL SPECIES

Toxicity values for mammals are based on an NOAEL of 75 or 15 mg a.e./kg/bw/day for acute and chronic exposure scenarios respectively (SERA 2004). Toxicity values for birds are based on an NOAEL of 670 or 15 mg a.e./kg/bw/day for acute and chronic exposure scenarios respectively (Ibid). No chronic toxicity studies in birds have been encountered so the chronic NOAEL for mammals is used in this assessment. Toxicity values for honey bees are based on an NOAEL of 909 mg/kg/bw.

While the plausibility of exposure is limited, all scenarios listed under the scenario section are considered here, except consumption of contaminated fish. No treatments are proposed in close proximity to Cherry Lake; therefore the scenario representing a bird eating a contaminated fish is not considered here.

There were no non-accidental acute exposure scenarios resulting in a Hazard Quotient that exceeds the designated NOAEL. In fact, all acute exposure HQs were several orders of magnitude below the threshold of 1. All but one chronic/longer-term exposure scenario resulted in Hazard Quotients several orders of magnitude below the threshold of NOAEL. The scenario considered for black-backed woodpeckers as chronic exposure and ingestion of contaminated fruit by a small bird had an HQ of 1.1, just above the threshold of concern, indicating the potential toxicological risk to individual woodpeckers. The small bird scenario represents a bird several times smaller than a black-backed woodpecker and thus is an extremely conservation assessment of potential risk. Additionally, because of the targeted spray application and the limited amount of acreage being sprayed across the landscape, it is unlikely that vegetation in close proximity to the weeds producing fruit eaten by woodpeckers would actually be sprayed.

In summary, Alternatives 1 and 5 have limited potential for direct or indirect individual effects from the proposed application of clopyralid as described above. The proposed application of clopyralid poses limited toxicological risk to terrestrial wildlife based on the limited area to be treated. It is also important to note that the exposure based on the risk assessment shows that all but one HQ is less than the NOAEL, most of them several orders of magnitude below the threshold of concern; therefore these species are provided an adequate margin of safety in the event that they are exposed to contaminated prey, vegetation or water.

Aminopyralid Analysis

Under Alternatives 1 and 5, about 546 acres are proposed for treatment of noxious weeds with aminopyralid. Treatment sites, the location of the target weeds, are spread across about 30,000 acres within the project area. Thistles, spotted knapweed, oxeye daisy, sulphur cinquefoil and tocalote would be the targeted species sprayed with aminopyralid. Aminopyralid would target each individual plant, not broadcast sprayed, so the number of non-target plants sprayed is assumed to be very few. Spraying would occur in the early to mid-spring before most if not all target weeds and surrounding vegetation were flowering. There is limited potential for terrestrial animal exposure throughout the project area. Reference Table 3.16-4 for all scenarios and associated HQ values cited below.

ALL SPECIES

Toxicity values for mammals are based on an NOAEL of 104 or 50 mg a.e./kg/bw/day for acute and chronic exposure scenarios respectively (SERA 2007). Toxicity values for birds are based on an NOAEL of 14 or 184 mg a.e./kg/bw/day for acute and chronic exposure scenarios respectively (Ibid). For honeybees, no mortality would be expected following acute exposure to doses up to 1,075 mg/kg based on direct spray studies and is considered a functional NOAEL (Ibid).

While the plausibility of exposure to wildlife is limited, all scenarios listed under the scenario section are considered here, except consumption of contaminated fish. No treatments are proposed in close proximity to Cherry Lake; therefore the bald eagle scenario representing a bird eating a contaminated fish is not considered here.

There were no chronic/longer-term exposure scenarios resulting in a Hazard Quotient that exceeds the designated NOAEL. In fact, all chronic HQs were several orders of magnitude below NOAEL. All but one non-accidental acute exposure scenario resulted in Hazard Quotients at or below NOAEL. The scenario considered for black-backed woodpeckers as non-accidental exposure and ingestion of contaminated insects by a small bird had an HQ of 1.8. The HQ value is slightly above the threshold of concern, indicating the potential for toxicological risk to individual woodpeckers. The small bird scenario represents a bird several times smaller than a black-backed woodpecker and thus is an extremely conservation assessment of potential risk. Additionally, because the insects black-backed woodpeckers prey upon are located under the bark of burned trees, it is unlikely that individuals would be exposed to aminopyralid at the level considered in this scenario.

In summary, Alternatives 1 and 5 have limited potential for direct or indirect individual effects from the proposed application of aminopyralid as described above. The proposed application of aminopyralid poses limited toxicological risk to terrestrial wildlife based on the limited area to be treated. However, it is important to note that the exposure based on the risk assessment shows that all but one HQ are well below the threshold of concern or No Observable Adverse Effect Level, most of them several orders of magnitude below this threshold; therefore, these species are provided an adequate margin of safety in the event that they are exposed to contaminated prey, vegetation, or water.

Clethodim Analysis

Under Alternatives 1 and 5, about 3,100 acres are proposed for treatment of noxious weeds. Treatment areas, the location of the target weeds, are spread across an area of about 45,000 acres within the project area. Medusahead and barbed goatgrass would be the targeted species sprayed with clethodim. Two of the largest areas, comprising about 80% of the treatment proposed for medusahead are in critical winter deer range and near Ackerson meadow, an important area for great gray owls. Implementing these treatments would improve habitat conditions in the short and long-term for these and many other species. Reference Table 3.16-5 for all scenarios and associated HQ values cited below.

Clethodim would be applied by directed foliar spraying, not broadcast spraying. Spraying would occur in the early spring before the target weeds and most surrounding vegetation were flowering. There is potential for terrestrial animal exposure within the project area.

ALL SPECIES

Toxicity values for mammals are based on an NOAEL of 100 or 19 mg a.e./kg/bw/day for acute and chronic exposure scenarios respectively (SERA 2014). Toxicity values for birds are based on an NOAEL of 950 or 20 mg a.e./kg/bw/day for acute and chronic exposure scenarios respectively (Ibid). For honeybees, a functional NOAEL is 860 mg/kg based on acute contact bioassays (Ibid).

While the plausibility of exposure to wildlife is limited, all scenarios listed under the scenario section are considered here, except consumption of contaminated fish. No treatments are proposed in close proximity to Cherry Lake; therefore the scenario representing a bird eating a contaminated fish is not considered here. No oral studies were available for honeybees; therefore, the scenario of invertebrates ingesting contaminated vegetation is not available for consideration in this analysis.

There were no chronic/longer-term exposure scenarios resulting in a Hazard Quotient that exceeds the designated NOAEL. In fact, all upper level (worst case scenario) HQs were well below 1.0, most of them several orders of magnitude below the threshold of 1.

In summary, there is a limited potential for direct or indirect individual effects from the proposed application of clethodim under Alternatives 1 and 5 as described above. The proposed application of clethodim poses some toxicological risk to terrestrial wildlife based on the limited area to be treated. It is also important to note that the exposure based on the risk assessment shows that all HQs are less than the threshold of concern, most of them several orders of magnitude below; therefore, these species are provided an adequate margin of safety in the event that they are exposed to contaminated prey, vegetation, or water.

Table 3.16-2 Summary of Hazard Quotients for Terrestrial Wildlife: Glyphosate

Receptor	CEN HQ[1]	LOW HQ[1]	UP HQ[1]	TOX VAL	TOX END
Non-Accidental Acute Exposures					
Contaminated Fruit [Lowest Residue Rates]					
Larger Mammal (400g)	4E-02	5E-03	0.1	500	NOAEL
Large Mammal (70 kg)	2E-02	3E-03	8E-02	500	NOAEL
Small bird (10g)	1E-01	2E-02	4E-01	1500	NOAEL
Large Bird (4 kg)	1E-02	2E-03	5E-02	1500	NOAEL
Contaminated Broadleaf Foliage					
Large Mammal (70 kg)	1E-01	1E-02	0.5	500	NOAEL
Insect	3E-01	5E-02	1.7	860	NOAEL
Contaminated Tall Grass					
Large Mammal (70 kg)	8E-02	8E-03	0.4	500	NOAEL
Contaminated Short Grass [Highest Residue Rate]					
Large Mammal (70 kg)	0.2	2E-02	0.9	500	NOAEL
Insect	6E-01	1E-01	3.0	860	NOAEL
Contaminated Water					
Small mammal (20g)	2E-05	2E-06	1E-04	500	NOAEL
Canid (5 kg)	9E-06	1E-06	7E-05	500	NOAEL
Large Mammal (70 kg)	7E-06	8E-07	5E-05	500	NOAEL
Small bird (10g)	1E-05	1E-06	7E-05	1500	NOAEL
Large Bird (4 kg)	1E-06	2E-07	1E-05	1500	NOAEL
Contaminated Insects					
Small mammal (20g)	0.2	2E-02	1.0	500	NOAEL
Small bird (10g)	0.1	1E-02	0.7	1500	NOAEL
Consumption of small mammal (after direct spray) by predator					
Canid (5 kg)	3E-02	8E-03	5E-02	500	NOAEL
Carnivorous bird (640 g)	1E-02	3E-03	2E-02	1500	NOAEL
Consumption of contaminated Fish					
Fish-eating bird (2.4 kg)	9E-07	1E-08	4E-05	1500	NOAEL
Chronic/Longer-Term Exposures					
Contaminated Fruit [Lowest Residue Rates]					
Larger Mammal (400g)	6E-03	8E-04	2E-02	500	NOAEL
Large Mammal (70 kg)	3E-03	5E-04	1E-02	500	NOAEL
Small bird (10g)	5E-01	7E-02	1.7	58	NOAEL
Large Bird (4 kg)	5E-02	7E-03	2E-01	58	NOAEL
Contaminated Broadleaf Foliage					
Large Mammal (70 kg)	2E-02	2E-03	8E-02	500	NOAEL
Contaminated Tall Grass					
Large Mammal (70 kg)	1E-02	1E-03	7E-02	500	NOAEL
Contaminated Short Grass [Highest Residue Rate]					
Large Mammal (70 kg)	3E-02	3E-03	0.1	500	NOAEL
Contaminated Water					
Small mammal (20g)	3E-07	1E-07	8E-06	500	NOAEL
Canid (5 kg)	2E-07	7E-08	5E-06	500	NOAEL
Large Mammal (70 kg)	1E-07	6E-08	4E-06	500	NOAEL
Small bird (10g)	4E-06	2E-06	1E-04	58	NOAEL
Large Bird (4 kg)	6E-07	3E-07	2E-05	58	NOAEL
Consumption of contaminated Fish					
Fish-eating bird (2.4 kg)	4E-07	2E-08	7E-05	58	NOAEL

CEN=Central; END=Endpoint; HQ=Hazard Quotient; LOW=Lower; TOX=Toxicity; UP=Upper; VAL=Value
[1] Application rate: 5 lb a.e./acre.

Table 3.16-3 Summary of Hazard Quotients for Terrestrial Wildlife: Clopyralid

Receptor	CEN HQ[1]	LOW HQ[1]	UP HQ[1]	TOX VAL	TOX END
Accidental Acute Exposures					
Direct Spray 100% absorption					
Honey Bee	4E-02	4E-02	4E-02	909	NOEC
Non-Accidental Acute Exposures					
Contaminated Fruit [Lowest Residue Rates]					
Larger Mammal (400g)	1E-03	2E-04	5E-03	75	NOAEL
Large Mammal (70 kg)	7E-03	9E-04	3E-02	75	NOAEL
Small bird (10g)	1E-02	2E-03	5E-02	670	NOAEL
Large Bird (4 kg)	1E-03	2E-04	5E-03	670	NOAEL
Contaminated Broadleaf Foliage					
Large Mammal (70 kg)	2E-01	2E-02	0.8	75	NOAEL
Contaminated Tall Grass					
Large Mammal (70 kg)	3E-02	3E-03	0.1	75	NOAEL
Contaminated Short Grass [Highest Residue Rate]					
Large Mammal (70 kg)	0.1	7E-03	0.3	75	NOAEL
Contaminated Water					
Small mammal (20g)	1E-05	2E-06	3E-05	75	NOAEL
Canid (5 kg)	6E-06	1E-06	2E-05	75	NOAEL
Large Mammal (70 kg)	4E-06	1E-06	2E-05	75	NOAEL
Small bird (10g)	2E-06	5E-07	7E-06	670	NOAEL
Large Bird (4 kg)	3E-07	7E-08	1E-06	670	NOAEL
Contaminated Insects					
Small mammal (20g)	0.1	6E-03	0.3	75	NOAEL
Small bird (10g)	2E-02	2E-03	0.1	670	NOAEL
Consumption of small mammal (after direct spray) by predator					
Canid (5 kg)	9E-03	3E-03	2E-02	75	NOAEL
Carnivorous bird (640 g)	1E-03	4E-04	2E-03	670	NOAEL
Chronic/Longer-Term Exposures					
Contaminated Fruit [Lowest Residue Rates]					
Larger Mammal (400g)	2E-02	3E-03	1E-01	15	NOAEL
Large Mammal (70 kg)	1E-02	2E-03	7E-02	15	NOAEL
Small bird (10g)	2E-01	3E-02	1.1	15	NOAEL
Large Bird (4 kg)	3E-02	3E-03	1E-01	15	NOAEL
Contaminated Broadleaf Foliage					
Large Mammal (70 kg)	7E-02	5E-03	4E-01	15	NOAEL
Contaminated Tall Grass					
Large Mammal (70 kg)	5E-02	4E-03	4E-01	15	NOAEL
Contaminated Short Grass [Highest Residue Rate]					
Large Mammal (70 kg)	1E-01	1E-02	0.8	15	NOAEL
Contaminated Water					
Small mammal (20g)	2E-05	2E-06	3E-05	15	NOAEL
Canid (5 kg)	1E-05	1E-06	2E-05	15	NOAEL
Large Mammal (70 kg)	8E-06	1E-06	1E-05	15	NOAEL
Small bird (10g)	3E-05	4E-06	6E-05	15	NOAEL
Large Bird (4 kg)	4E-06	6E-07	8E-06	15	NOAEL

CEN=Central; END=Endpoint; HQ=Hazard Quotient; LOW=Lower; TOX=Toxicity; UP=Upper; VAL=Value
[1] Application rate: .25 lb a.e./acre.

Table 3.16-4 Summary of Hazard Quotients for Terrestrial Wildlife: Aminopyralid

Receptor	CEN HQ[1]	LOW HQ[1]	UP HQ[1]	TOX VAL	TOX END
Accidental Acute Exposures					
Direct Spray 100% absorption					
Honey Bee	2E-02	2E-02	2E-02	1075	NOEC
Non-Accidental Acute Exposures					
Contaminated Fruit [Lowest Residue Rates]					
Larger Mammal (400g)	4E-03	5E-04	1E-02	104	NOAEL
Large Mammal (70 kg)	2E-03	3E-04	8E-03	104	NOAEL
Small bird (10g)	3E-01	4E-02	1.0	14	NOAEL
Large Bird (4 kg)	3E-02	4E-03	1E-01	14	NOAEL
Contaminated Broadleaf Foliage					
Large Mammal (70 kg)	1E-02	1E-03	0.1	104	NOAEL
Contaminated Tall Grass					
Large Mammal (70 kg)	8E-03	8E-04	4E-02	104	NOAEL
Contaminated Short Grass [Highest Residue Rate]					
Large Mammal (70 kg)	2E-02	2E-03	0.1	104	NOAEL
Contaminated Water					
Small mammal (20g)	2E-05	3E-07	9E-05	104	NOAEL
Canid (5 kg)	9E-06	2E-07	5E-05	104	NOAEL
Large Mammal (70 kg)	7E-06	1E-07	4E-05	104	NOAEL
Small bird (10g)	2E-04	4E-06	1E-03	14	NOAEL
Large Bird (4 kg)	3E-05	6E-07	2E-04	14	NOAEL
Contaminated Insects					
Small mammal (20g)	2E-02	2E-03	0.1	104	NOAEL
Small bird (10g)	0.3	3E-02	1.8	14	NOAEL
Consumption of small mammal (after direct spray) by predator					
Canid (5 kg)	3E-03	9E-04	5E-03	104	NOAEL
Carnivorous bird (640 g)	3E-02	8E-03	4E-02	14	NOAEL
Chronic/Longer-Term Exposures					
Contaminated Fruit [Lowest Residue Rates]					
Larger Mammal (400g)	2E-03	2E-04	7E-03	50	NOAEL
Large Mammal (70 kg)	1E-03	1E-04	4E-03	50	NOAEL
Small bird (10g)	4E-03	5E-04	2E-02	184	NOAEL
Large Bird (4 kg)	5E-04	5E-05	2E-03	184	NOAEL
Contaminated Broadleaf Foliage					
Large Mammal (70 kg)	5E-03	4E-04	3E-02	50	NOAEL
Contaminated Tall Grass					
Large Mammal (70 kg)	4E-03	3E-04	2E-02	50	NOAEL
Contaminated Short Grass [Highest Residue Rate]					
Large Mammal (70 kg)	9E-03	7E-04	0.1	50	NOAEL
Contaminated Water					
Small mammal (20g)	1E-05	3E-07	8E-05	50	NOAEL
Canid (5 kg)	7E-06	2E-07	5E-05	50	NOAEL
Large Mammal (70 kg)	6E-06	1E-07	4E-05	50	NOAEL
Small bird (10g)	6E-06	2E-07	4E-05	184	NOAEL
Large Bird (4 kg)	9E-07	2E-08	6E-06	184	NOAEL

CEN=Central; END=Endpoint; HQ=Hazard Quotient; LOW=Lower; TOX=Toxicity; UP=Upper; VAL=Value
[1] Application rate: .11 lb a.e./acre.

Table 3.16-5 Summary of Hazard Quotients for Terrestrial Wildlife: Clethodim

Receptor	CEN HQ[1]	LOW HQ[1]	UP HQ[1]	TOX VAL	TOX END
Accidental Acute Exposures					
Direct Spray 100% absorption					
Honey Bee	5E-02	5E-02	5E-02	860	NOEC
Non-Accidental Acute Exposures					
Contaminated Fruit [Lowest Residue Rates]					
Larger Mammal (400g)	9E-03	1E-03	3E-02	100	NOAEL
Large Mammal (70 kg)	5E-03	7E-04	2E-02	100	NOAEL
Small bird (10g)	9E-03	1E-03	3E-02	950	NOAEL
Large Bird (4 kg)	1E-03	1E-04	4E-03	950	NOAEL
Contaminated Broadleaf Foliage					
Large Mammal (70 kg)	2E-02	2E-03	0.1	100	NOAEL
Insect					
Contaminated Tall Grass					
Large Mammal (70 kg)	2E-02	2E-03	0.1	100	NOAEL
Contaminated Short Grass [Highest Residue Rate]					
Large Mammal (70 kg)	5E-02	5E-03	0.2	100	NOAEL
Contaminated Water					
Small mammal (20g)	1E-05	5E-09	2E-04	100	NOAEL
Canid (5 kg)	6E-06	3E-09	1E-04	100	NOAEL
Large Mammal (70 kg)	5E-06	2E-09	9E-05	100	NOAEL
Small bird (10g)	2E-06	1E-09	4E-05	950	NOAEL
Large Bird (4 kg)	3E-07	1E-10	5E-06	950	NOAEL
Contaminated Insects					
Small mammal (20g)	5E-02	5E-03	0.2	100	NOAEL
Small bird (10g)	1E-02	1E-03	6E-02	950	NOAEL
Consumption of small mammal (after direct spray) by predator					
Canid (5 kg)	7E-03	2E-03	1E-02	100	NOAEL
Carnivorous bird (640 g)	8E-04	3E-04	1E-03	950	NOAEL
Chronic/Longer-Term Exposures					
Contaminated Fruit [Lowest Residue Rates]					
Larger Mammal (400g)	4E-03	6E-04	2E-02	19	NOAEL
Large Mammal (70 kg)	3E-03	3E-04	1E-02	19	NOAEL
Small bird (10g)	4E-02	5E-03	0.2	20	NOAEL
Large Bird (4 kg)	5E-03	6E-04	2E-02	20	NOAEL
Contaminated Broadleaf Foliage					
Large Mammal (70 kg)	1E-02	1E-03	7E-02	19	NOAEL
Contaminated Tall Grass					
Large Mammal (70 kg)	1E-02	9E-04	5E-02	19	NOAEL
Contaminated Short Grass [Highest Residue Rate]					
Large Mammal (70 kg)	2E-02	2E-03	0.1	19	NOAEL
Contaminated Water					
Small mammal (20g)	2E-05	1E-08	6E-04	19	NOAEL
Canid (5 kg)	3E-04	1E-07	6E-03	1	NOAEL
Large Mammal (70 kg)	1E-05	4E-09	3E-04	19	NOAEL
Small bird (10g)	4E-05	2E-08	1E-03	20	NOAEL
Large Bird (4 kg)	6E-06	2E-09	1E-04	20	NOAEL

CEN=Central; END=Endpoint; HQ=Hazard Quotient; LOW=Lower; TOX=Toxicity; UP=Upper; VAL=Value
[1] Application rate: .25 lb a.e./acre.

Valley Elderberry Longhorn Beetle: Affected Environment

Species and Habitat Account

The valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) is listed as Threatened under the Endangered Species Act. There is no Designated Critical Habitat on the Stanislaus. The valley elderberry beetle (VELB) is thought to range from the Central Valley into the eastern portion of the Coast Range and the foothills of the Sierra Nevada up to approximately 3,000 feet (USFWS 1999).

This species is most often found along the margins of rivers and streams in the lower Sacramento River and upper San Joaquin Valley. The current known range of the VELB extends from southern Shasta County south to Fresno County (Barr 1991).

Habitat for the VELB consists of elderberry shrubs and trees in a variety of habitats and plant communities, but most often in riparian, elderberry savannah or moist valley oak woodlands. Common associated plants include *Populus spp., Salix spp., Fraxinus spp., Quercus spp., Juglans spp., Acer negundo, Rubus spp., Toxicodendron diversiloba, Vitis californica, Rosa spp., and Baccharis spp*. (USFWS 2006a). VELB appear to favor sites with high elderberry densities and are limited in their ability to disperse and colonization new sites (Collinge et al. 2001).

Valley elderberry longhorn beetles have not been observed or documented on the Stanislaus; however, presence is assumed where elderberry plants with stems greater than 1 inch at the base are found. Most of the elderberry plants damaged by the Rim Fire have resprouted and some have actually grown so quickly they are of adequate size to host elderberry beetles (Baumbach pers. obs.). All proposed treatment units at or below 3,000 foot elevation have been surveyed. Three elderberry shrubs were found in one proposed reforestation unit (Z030). All three plants are resprouts from plants burned at high severity in the Rim Fire and no exits holes were observed. The nearest documented VELB occurrence was one beetle on an elderberry shrub almost 24 miles to the west of the fire near Jamestown in 2002.

Eggs are laid in late spring on elderberry stems greater than 1 inch in diameter on healthy and unstressed plants. Larvae excavate passages into the elderberry shrub where they may remain in larval form for as long as two years before they emerge as adults. Exit holes are usually on stems greater than 0.5 inches in diameter, with 70% of the exit holes at heights of 4 feet or greater; these holes are circular to slightly oval, with a diameter of 7 to 10 mm (Barr 1991).

VELB has been found only in association with its host plant, elderberry. Adults feed on the foliage and perhaps flowers of elderberry plants, and are present from March through early June (Barr 1991).

About 25,413 acres of potential elderberry habitat is below 3,000 foot elevation within the analysis area. About 25,517 acres of potential elderberry habitat is within the cumulative analysis area, mainly in the river canyons where treatments are not proposed.

RISK FACTORS IDENTIFIED FOR VELB

1. *Loss or alteration of habitat*: The primary threat to survival of VELB is the loss or alteration of habitat. Stream development and urbanization have resulted in the removal of significant amounts of suitable habitat. On NFS lands, cattle grazing has heavily damaged elderberry in some areas and may reduce the quantity and quality of available habitat.
2. *Pesticides and Herbicides*: Individual beetles, localized beetle populations, and plants are subject to injury or loss from pesticide applications. Pesticides pose a risk to the VELB and its host plant. Some chemicals from the valley are known to drift upslope and into the Sierra on prevailing wind currents (McConnell et al. 1998, Bradford et al. 2010). Smaller amounts of pesticides and

herbicides are used in the local area by the Forest Service to control shrubs and noxious weeds, and lesser amounts are used by surrounding local landowners.

3. *Predation*: Predation by birds, other insects and small mammals may have negative effects on localized populations.
4. *Argentine Ant*: The widely established non-native Argentine Ant (*Linepithema humile*) also poses a threat to VELB. While Argentine Ants are common in the core valley habitat of the VELB, it does not appear to be widely established in the Sierra foothills, likely due to summer drought or winter cold.

MANAGEMENT DIRECTION

Conservation Guidelines for VELB are provided in USFWS (1999). While there is no Designated Critical Habitat on the Stanislaus, habitat exists and so there is the potential for the beetle to occur on the forest. 2.02 Alternatives Considered in Detail identifies the management requirements that would mitigate adverse effects to this species under the proposed action and are consistent with the VELB Conservation Measures (USFWS 1999).

Valley Elderberry Longhorn Beetle: Environmental Consequences

The project action alternatives could result in direct and indirect effects to the VELB through the following activities:

- Site preparation for planting conifers (e.g., dozer piling or herbicide application).
- Broadcast prescribed fire or pile burning.

These direct and indirect effects include:

- Project related death, injury and disturbance.
- Project related modifications to habitat quality.

Death, Injury and Disturbance

Death or injury of larvae and elderberry shrubs from project related mechanical activities would be unlikely to occur given the mechanical activity buffers around elderberry plants and Limited Operating Periods (LOPs) which would eliminate the potential for dust and smoke impacts. Death or injury from herbicide application would be unlikely to occur given the prohibition of spraying elderberry shrubs and the 100 foot buffer protecting each shrub. Larvae and the elderberry plants would be protected by these buffers. Prescribed burning operations in unit Z030 has the potential to burn individual plants; however, vegetation around existing plants would be pulled back so the risk is considered extremely low.

Project Related Modifications to Habitat Quality

No modification of habitat quality is expected from mechanical treatments or pile burning because all identified elderberry plants with stems greater than 1 inch in diameter would have a buffer prohibiting mechanical activities within ten feet of shrubs. There is a very low risk of the loss of individual shrubs during prescribed fire operations because vegetation surrounding individual shrubs would be pulled away from the shrubs.

Indicators

The following indicators were chosen to provide a relative measure of the direct and indirect effects to the VELB and to determine how well project alternatives comply with the species' conservation strategy.

1. Disturbance potential
2. Habitat alteration potential

3. Toxicological effects from herbicide use

Alternatives 1, 3 and 5

Because the reforestation treatment areas proposed under Alternatives 1, 3 and 5 are the same, the effects for indicators 1 and 2 are expected to be the same and are therefore analyzed together.

DIRECT AND INDIRECT EFFECTS

Three elderberry shrubs exist within proposed treatment unit Z030. Contractors will be briefed on the need to avoid damaging the elderberry plants and the possible penalties for not complying with these requirements. All crews working in the area would be instructed on the status of the beetle and the need to protect its host plant.

Indicator 1

Because virtually all of the VELB lifecycle is spent on elderberry shrubs, either inside the stems as larvae or on the foliage or flowers as adults, the greatest risk to individuals would come from activities in the immediate vicinity of elderberry plants.

Buffers applied to individual plants where no mechanical activity would occur and LOPs during the adult flight period restricting activities would eliminate almost all risk to individuals associated with project implementation.

Buffers applied prohibiting herbicide application within 100 feet of elderberry shrubs would provide protection to plants and individual larvae and beetles. Because elderberry beetles are found only in association with elderberry plants, there is an extremely low risk of beetles coming in contact with herbicides on other species of plant.

Given the mitigation measures in place, the potential for death or injury of individual plants, larvae or adult beetles is either insignificant (i.e., cannot be meaningfully measured, detected or evaluated) or discountable (i.e., extremely unlikely to occur).

Indicator 2

Similar to indicator 1, buffers applied to individual shrubs would eliminate almost all risk of habitat alteration and effects to individual elderberry shrubs. Additionally, pulling back vegetation away from individual shrubs would eliminate almost all risk to shrubs from prescribed fire operations.

Operating heavy equipment may result in excess deposition of dust and other particulate matter on individual plants; however, a study of proximity to roads and dust impacts to elderberry plants found no evidence of negative effects (Talley et al. 2006).

Based on the above analysis and the fact that no elderberry beetles have been documented in the project area or the forest, the potential for disturbance or habitat alteration with respect to VELB is either insignificant (i.e., cannot be meaningfully measured, detected, or evaluated) or discountable (i.e., extremely unlikely to occur).

CUMULATIVE EFFECTS

Appendix B identifies the present and reasonably foreseeable future actions on all lands within the analysis area. Some, but not all of these actions have or may contribute cumulatively to effects on VELB.

Habitat modification was used as a relative measure of cumulative effects of the action alternatives.

The potential habitat area below 3,000 foot elevation is almost entirely within the Tuolumne River Canyon and its tributaries, and a small portion of Grapevine Creek, which is managed by the Forest Service and the Bureau of Land Management. Much of the Tuolumne River aside from the Hetch-Hetchy facilities are designated and managed as Wild and Scenic River.

Habitat Modification

Federal Lands

The Rim HT and Rim Recovery projects are the only two present actions on public lands within the potential habitat area. The actions presently underway include about 152 acres of tractor or hand piling and burning associated with the Rim Recovery project and about 827 acres of tractor piling associated with the Rim HT project. These projects are not likely to affect habitat suitability for VELB because management requirements approved by USFWS are in place and will protect elderberry plants and the VELB.

Livestock grazing is both a present and foreseeable future action on federal lands within potential habitat area. Cattle grazing has heavily damaged elderberry in some areas and may reduce the quantity and quality of available habitat across about 12,126 acres within the analysis area.

Private Lands

The cumulative effects analysis area contains private timberland, residential areas and rangeland below 3,000 feet where elderberry plants and beetles may occur. Some of the private inholdings include meadows and associated riparian habitat that may support elderberry shrubs. Power plants, dams, powerlines and other facilities associated with Hetch-Hetchy also exist in the Tuolumne River Canyon and Cherry Creek within the elevation range of VELB. Some of this infrastructure intersects with NFS lands and is under special use permits.

Seven acres of NFS lands have a future special use permit proposed for vegetation treatments associated with the Reliable Power Project. About two acres of shredding or mastication and 5 acres of chemical application to control vegetation under powerlines have been proposed. Reliable Power would establish an agreement, if one is not already in place, with USFWS regarding VELB and their habitat and are expected to adhere to those requirements as part of their special use permit.

No other present or foreseeable future actions are proposed on private lands within the potential habitat area.

Alternatives 1, 3 and 5 Contribution and Summary

Because the Rim Reforestation project is not expected to result in any measurable effects to VELB, it is not expected to contribute to cumulative effects.

Alternatives 1 and 5

DIRECT AND INDIRECT EFFECTS

Indicator 3

Under Alternatives 1 and 5, herbicide use is expected to have no toxicological effects upon VELB because a buffer of 100 feet around all three elderberry shrubs in unit Z030 would be utilized.

CUMULATIVE EFFECTS

Because the Rim Reforestation project is not expected to result in any measurable effects to VELB, it is not expected to contribute to cumulative effects.

Alternative 2

DIRECT AND INDIRECT EFFECTS

Under No Action, death, injury and disturbance would not be an issue because no active management would occur.

The indirect effects of Alternative 2 are primarily related to the influence no action may have on future wildfires and how future wildfires may impact VELB habitat.

Indicator 1

Because no management activities would occur under this alternative, no project related direct effects to individual valley elderberry longhorn beetles or larvae or elderberry shrubs would occur.

Indicator 2

Within the areas that burned at high severity, elderberry shrubs and other herbaceous and shrub vegetation have become somewhat reestablished over the past two years. This vegetation is expected to continue to reestablish itself over the next two to three years. Elderberry shrubs that are of appropriate size for beetle and larvae occupancy can provide suitable habitat for VELB. These benefits are expected in the short-term (10 to 20 years). Elderberry shrubs are expected to be vulnerable to loss in a future wildfire; but these plants are expected to resprout vigorously as they have done after previous fire events.

Indicator 3

Because no herbicides are proposed under this alternative, no exposure to herbicides and no direct, indirect or cumulative toxicological effects would occur under this alternative.

CUMULATIVE EFFECTS

The cumulative effects analysis discussion under Alternatives 1, 3 and 5 outlines those present and foreseeable future activities scheduled on public and private lands considered under this alternative.

Alternative 2 Contribution and Summary

The cumulative contribution of Alternative 2 is attributed to the influence no action would have on how future wildfires may adversely impact elderberry habitat. Elderberry shrubs are expected to be vulnerable to loss in a future wildfire; but these plants are expected to resprout vigorously as they have done after previous fire events.

Alternative 3

Indicator 3

Because no herbicides are proposed under this alternative, no exposure to herbicides and no direct, indirect or cumulative toxicological effects to VELB would occur under this alternative.

Alternative 4

No management activities are proposed where elderberry shrubs occur; therefore, direct, indirect, and cumulative effects are expected to be the same as those described under the No Action alternative.

Valley Elderberry Longhorn Beetle: Summary of Effects

Alternatives 1, 3 and 5 would be unlikely to have any adverse direct or indirect effects to the VELB.

All elderberry plants capable of supporting VELB would be flagged and avoided. LOPs or buffers would be in place under Alternatives 1, 3 and 5 to eliminate negative impacts from dust, smoke or herbicides. No management activities occur within habitat under Alternative 4; therefore, effects are expected to be the same as under the No Action alternative.

Determinations

Implementing the Rim Reforestation Project Alternatives 1, 3 or 5 has very little potential to impact individual valley elderberry longhorn beetles and the elderberry habitat required by the species. The surveys and buffers established around individual plants and project management requirements would greatly reduce the potential risk associated with direct and indirect effects to individual VELB or associated elderberry plants. The project does not occur within Designated Critical Habitat for the species and would have no effect on critical habitat; however, the primary constituent elements occur within and adjacent to the project area indicating suitable habitat is present. Therefore, the following determinations are supported by this analysis. Specifically, the potential for effects to VELB from implementation of the alternatives are either discountable (i.e. extremely unlikely to occur) or insignificant (i.e. cannot be meaningfully measured, detected or evaluated).

ALTERNATIVES 1 AND 5

Alternatives 1 and 5 may affect but are not likely to adversely affect the valley elderberry longhorn beetle. Alternatives 1 and 5 would not affect Designated Critical Habitat for the valley elderberry longhorn beetle. This is based on the following rationale:

- The valley elderberry longhorn beetle has never been documented to occur on the Stanislaus National Forest. (discountable effect)
- All elderberry plants greater than 1 inch stem diameter would be flagged and avoided where they occur (unit Z030). (discountable effect)
- Any ground based mechanical equipment operations or burning within 10 feet of elderberry plants would be prohibited. (discountable effect)
- Herbicide application within 100 of elderberry shrubs with stems greater than 1 inch dbh is prohibited.
- Pile and broadcast burning, and mechanical activities within 100 feet of flagged shrubs would be subject to an LOP from April 1 through June 30 to prevent smoke or dust impacts to beetles. (discountable effect)

ALTERNATIVES 2 AND 4

Alternatives 2 and 4 may affect but are not likely to adversely affect the valley elderberry longhorn beetle. Alternatives 2 and 4 would not affect Designated Critical Habitat for the valley elderberry longhorn beetle. This is based on the following rationale:

- The valley elderberry longhorn beetle has never been documented to occur on the Stanislaus.
- There is potential for loss of habitat or individuals in a future fire (natural or human caused).

ALTERNATIVE 3

Alternative 3 may affect but is not likely to adversely affect the valley elderberry longhorn beetle. Alternative 3 would not affect Designated Critical Habitat for the valley elderberry longhorn beetle. This is based on the following rationale:

- The VELB has never been documented to occur on the Stanislaus. (discountable effect)
- All elderberry plants greater than 1 inch stem diameter would be flagged and avoided where they occur (unit Z030). (discountable effect)
- Any ground based mechanical equipment operations and burning within 10 feet of elderberry plants would be prohibited. (discountable effect)
- Pile and broadcast burning, and mechanical activities within 100 feet of flagged shrubs would be subject to an LOP from April 1 through June 30 to prevent smoke or dust impacts to beetles. (discountable effect)

Further rationale for determinations:

Guidance provided in the Endangered Species Consultation Handbook (USFWS and NMFS 1998, page 3 to12) indicates that “MAY AFFECT BUT IS NOT LIKELY TO ADVERSELY AFFECT” is the appropriate conclusion when effects on listed species are expected to be discountable, or insignificant, or completely beneficial. Discountable effects are those that are extremely unlikely to occur. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Beneficial effects are positive effects without adverse effects to the species.

Valley Elderberry Longhorn Beetle: Compliance

The action alternatives would not affect the recovery plan objectives for the VELB. The recovery plan objectives for VELB are to minimize further degradation, development or environmental modification of VELB habitat, and to delist the VELB (USFWS 1984).

Bald Eagle: Affected Environment

Species and Habitat Account

The bald eagle (*Haliaeetus leucocephalus*) is a Region 5 Forest Service Sensitive species. The bald eagle breeds primarily in specific and localized large rivers and lakes of the northern third of California, with scattered nesting throughout the state.

Bald eagles typically nest in live trees, some with dead tops, and build a large (approximately 6 foot diameter), generally flat-topped and cone-shaped nest usually below the top with some cover above the nest (Jackman and Jenkins 2004). In general, bald eagles require a large tree to accommodate a large nest in a relatively secluded location within the range of their tolerance of human disturbance (Ibid). Diurnal perch habitat is characterized by the presence of tall, easily accessible; often predominate trees adjacent to shoreline foraging habitat (Buehler 2000). The entire breeding cycle, from initial activity at a nest through the period of fledgling dependency, is about 8 months (Ibid).

The project is within the current distribution of bald eagles in California. The one bald eagle nest site in the project area and is located at Cherry Lake. This site has been occupied for more than 16 years. Although nest trees have changed over this period, the nest site has consistently been in the same general stand on the Cherry Lake shoreline. The post-fire condition of the nest, nest tree, and nest stand all appear intact and suitable (Baumbach, pers. obs.). After over 16 years of being occupied as a bald eagle territory, it appears the carrying capacity of Cherry Lake is limited to one pair of breeding bald eagles. Bald eagles also use the Cherry Lake area during migration and for overwintering (NRIS Wildlife database). No treatments are proposed within one half mile of this nest site; therefore, an LOP for this species is not required. The nearest unit is about one mile south of the current nest site.

RISK FACTORS

USDA (2001) summarized risk factors potentially influencing bald eagle abundance and distribution:

1. Nest site loss and disturbance.
2. Loss of habitat and habitat components such as potential nest or roost trees.

MANAGEMENT DIRECTION

Current management direction for bald eagle is to follow all law, regulation, and policy as it relates to bald eagle because the species is still vulnerable to potential disturbance impacts and is still within the delisting monitoring period (R5 Sensitive species evaluation form of 2012). Forest Plan Direction (2010) p.43 states: When nesting bald eagles are found, implement suitable restrictions on nearby activities based on the Regional habitat management guidelines and the habitat capability model for the species. Protect all historic and active nests, as required by the Eagle Protection Act and the Migratory Bird Treaty Act.

The Eagle Protection Act (16 U.S.C. 668-668c), enacted in 1940, and amended several times since then, prohibits anyone, without a permit issued by the Secretary of the Interior, from “taking” bald eagles, including their parts, nests, or eggs. The Act provides criminal and civil penalties for persons who disturb nest sites by substantially interfering with normal breeding, feeding, or sheltering behavior (USFWS 2007).

The Migratory Bird Treaty Act (MBTA), 16 U.S.C. 703-712, prohibits the taking of any migratory bird or any part, nest, or egg, except as permitted by regulation. The MBTA was enacted in 1918; a

1972 agreement supplementing one of the bilateral treaties underlying the MBTA had the effect of expanding the scope of the Act to cover bald eagles and other raptors.

Habitat management guidelines to follow for bald eagle are provided by the National Bald Eagle Management Guidelines (USFWS 2007).

Bald Eagle: Environmental Consequences

The project alternatives could result in direct and indirect effects to the bald eagle through the following activities:

- Mechanical site preparation for planting.
- Herbicide application for conifer survival and growth.
- Planting conifers.

These direct and indirect effects include:

- Project related death, injury and disturbance.
- Project related modifications to habitat quantity and/or quality.

Death, Injury and Disturbance

Death, injury, and disturbance are potential direct effects to consider for bald eagle (USDA 2004). Disturbance issues are expected to be most pronounced within a half mile of nests (USFWS 2007). No activities are proposed within one half mile of the known nest site at Cherry Lake. Therefore, the risk of death, injury, or disturbance from project activities is extremely low. Human presence related to proposed activities more than one mile from the nest site is not likely to change normal behavior or impair essential behavior patterns of the bald eagle related to breeding, feeding, or sheltering. While herbicide application in new plantations is unlikely to affect bald eagles directly, small mammals and birds eaten by eagles have the potential to be exposed to herbicides and therefore could result in bald eagle exposure if consuming exposed prey. This scenario is considered highly unlikely and the risk extremely low.

Habitat Modification

Planting conifers is proposed within 500 feet of Cherry Lake which is within an area bald eagles could use to nest and forage. Bald eagles focus nesting, roosting and perching behaviors along shorelines and habitat modification effects are expected to be most pronounced within 500 feet of lake shorelines (Jackman and Jenkins 2004). Bald eagles will roost and perch in relatively small trees, while the average nest tree size documented in California used by bald eagles is 43 inches dbh and 131 feet tall (Lehman 1979).

Indicators

The following indicators were chosen to provide a relative measure of the direct and indirect effects to the bald eagle and to determine how well project alternatives comply with Forest Plan Direction.

1. Treatments within 500 feet of lake shorelines.
2. Toxicological effects from herbicide use.

This criterion was chosen based on the best available scientific literature which focuses on various aspects of bald eagle ecology and life history requirements. This criterion focuses on the life history aspects, or habitat elements, considered most limiting to bald eagle persistence across their range and where project effects are expected.

Alternatives 1, 3 and 5

Because there is no difference in areas proposed for reforestation or thinning, under these three alternatives, the effects are expected to be similar and are analyzed together. The differences in herbicides proposed between Alternatives 1 and 5 versus Alternative 3 were separated below accordingly.

DIRECT AND INDIRECT EFFECTS

Indicator 1

Only a small portion of one reforestation unit (24 acres) occurs within 500 feet of Cherry Lake. In the short-term, up to 20 years, the planted area would provide little benefit to eagles because the trees would be of small size and would not contribute to roosting or perching habitat. In the long-term, benefits to eagles include additional perch and roost sites adjacent to the shoreline. It is unlikely that trees would grow to a sufficient size to be used as nesting trees until well beyond 50 years. Several existing plantation units near Cherry Lake are proposed for thinning and the removal of dead material, pockets of mortality from the Rim Fire. Thinning these plantations is expected to result in accelerated growth rates in remaining trees, providing additional nest, perch and roosting trees sooner than without treatments. Additionally, removal of dead material would result in reduced fuel loading. The combination of treatments is expected to improve the resiliency of these stands when fire returns to this landscape.

Indicator 2

Under Alternatives 1 and 5, herbicide use is expected to have a limited potential for direct or indirect toxicological effects on bald eagles as described under the herbicide risk assessment section. Because no herbicides are proposed under Alternative 3, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to bald eagles would occur under this alternative.

CUMULATIVE EFFECTS

Appendix B identifies the present and reasonably foreseeable future actions on all the lands within the analysis area including non-Forest Service and private. Some, but not all of these actions have or may contribute cumulatively to effects on bald eagles.

Based on risk factors affecting bald eagle, the following relevant evaluation criteria were used as relative measures of cumulative effects from this alternative to eagles: disturbance, nest and roost site availability, and toxicological effects.

Disturbance

Federal Lands

Recreational use adjacent to Cherry Lake is the only present and foreseeable action and it is limited to existing and mostly quiet uses in this area (i.e. primarily trailhead parking, motor boats and hiking). Based on continued nesting by the bald eagles at this location, these recreation activities do not affect bald eagle behavior.

Private Lands

No private land activities exist within one half mile of the known nest site or within 500 feet of Cherry Lake.

Nest and Roost Site Availability

No present or foreseeable future federal or private activities are proposed in close proximity to Cherry Lake that would affect the availability of nest and roost sites for bald eagles.

Toxicological Effects

Federal Lands

One present federal action of herbicide use on 0.5 acres under the Rim Fire Rehabilitation project and two foreseeable federal actions of herbicide use: 8.0 acres under the Twomile Ecological Restoration Noxious Weed project and 23 acres under a special use permit for the Reliable Power Project powerline. No other present or foreseeable future federal actions are related to herbicide use.

Private Lands

Herbicide use is proposed on 1,583 acres of private land within the project area in 2017. No other present or foreseeable future actions are proposed on private lands related to herbicide application.

Alternatives 1, 3 and 5 Contribution and Summary

The limited scope and duration of treatments under these alternatives is not expected to cumulatively contribute to disturbance effects to bald eagles. Planting conifers adjacent to Cherry Lake would provide potential nest, perch and roost sites for bald eagles in the long-term. Thinning plantations and removing dead material would result in faster growth rates of remaining trees and increasing the resiliency of these stands, reducing the risk of loss when fire returns to this area. There is limited potential for toxicological effects from herbicide use to bald eagles under Alternatives 1 and 5. The cumulative contribution of these alternatives on bald eagles is considered minor and is not expected to affect the viability of this species.

Alternative 2

DIRECT AND INDIRECT EFFECTS

Under No Action, death, injury and disturbance would not be an issue because no active management would occur.

Indicator 1

The indirect effects of no action are primarily related to the influence no action may have on the amount and location of suitable forested habitat available to bald eagles adjacent to Cherry Lake. Under Alternative 2, no management activities would occur within 500 feet of Cherry Lake. The only tree expansion into this area could occur as a result of natural regeneration. Because no active management would occur, it is unknown where naturally regenerating forest would occur. It is likely that areas in close proximity to live trees (i.e. seed source) would experience forest expansion to a limited degree. If plantations near Cherry Lake are not treated these stands may be at increased risk of loss when fire returns to the landscape, which would negatively affect bald eagles in the area.

Indicator 2

Because no herbicides are proposed under this alternative, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to bald eagles would occur under this alternative.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 2 Contribution/Summary

Alternative 2 is not expected to contribute to direct, indirect, or cumulative effects related to disturbance. There may be indirect consequences under this alternative primarily related to the influence no action may have on forest development and plantation resiliency adjacent to Cherry Lake and how that may impact bald eagles. It is unknown how much and when natural forest recovery would occur adjacent to Cherry Lake, which could delay the availability of nest, perch and roost sites in the area. The older plantations adjacent to Cherry Lake may be at greater risk of loss when fire returns. Alternative 2 cumulative contributions to effects on bald eagles are considered minor and are not expected to affect the viability of this species.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Indicator 1

Under Alternative 4, no reforestation is proposed within 500 feet of Cherry Lake. Plantation units near Cherry Lake are proposed for treatments under this alternative. The prescriptions and effects are expected to be the same as described under Alternatives 1, 3 and 5.

Indicator 2

The herbicide use proposed under Alternative 4 is expected to have a limited potential for direct or indirect toxicological effects on bald eagles as described under the herbicide risk assessment section.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 4 Contribution/Summary

Alternative 4 is not expected to contribute to direct, indirect, or cumulative effects related to disturbance. The indirect consequence under this alternative is related to the influence not reforesting areas adjacent to Cherry Lake would impact bald eagles. It is unknown how much and when natural forest recovery would occur adjacent to Cherry Lake, which could delay the availability of nest, perch, and roost sites in the area. Thinning plantations and removing dead material would result in faster growth rates of remaining trees and increasing the resiliency of these stands, reducing the risk of loss when fire returns to this area. There is limited potential for toxicological effects from herbicide use to bald eagles under Alternative 4. The cumulative contribution of this alternative on bald eagles is considered minor and is not expected to affect the viability of this species.

Bald Eagle: Summary of Effects

Effects to bald eagles under all action alternatives are considered negligible to minor. Alternatives 1, 3 and 5 would result in the accelerated development of forested habitat adjacent to Chery Lake, which would more quickly benefit bald eagles using this area. Thinning of existing plantations is the same under all action alternatives and is expected to benefit bald eagles through the accelerated growth of remaining trees and resiliency when fire returns to the landscape.

Determinations

ALTERNATIVES 1 AND 5

Alternatives 1 and 5 may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the bald eagle. This determination is based on the following rationale:

- These alternatives include actions to accelerate the development of forested habitat adjacent to Cherry Lake, an occupied bald eagle territory.
- These alternatives would improve existing plantation conditions by accelerating growth rates of potential nest, perch and roost trees and improving stand resilience when fire returns.
- These alternatives may result in negligible affects from herbicide use.

ALTERNATIVE 2

Alternative 2 may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the bald eagle. This determination is based on the following rationale:

- No actions would occur to potentially impact this species or habitat. However, with no action to thin plantations or accelerate the development of important habitat elements such as perch, roost or nest sites adjacent to Cherry Lake, habitat recovery would be delayed and plantations are at greater risk of loss from fire.

Alternative 3

Alternative 3 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the bald eagle. This determination is based on the following rationale:

- This alternative includes actions to accelerate the development of forested habitat adjacent to Cherry Lake, an occupied bald eagle territory.
- This alternative would improve existing plantation conditions by accelerating growth rates of potential nest, perch and roost trees and improving stand resilience when fire returns.

Alternative 4

Alternative 4 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the bald eagle. This determination is based on the following rationale:

- This alternative does not include actions to accelerate the development of forested habitat adjacent to Cherry Lake, an occupied bald eagle territory.
- This alternative would improve existing plantation conditions by accelerating growth rates of potential nest, perch, and roost trees and improving stand resilience when fire returns.
- This alternative may result in negligible affects from herbicide use.

Bald Eagle: Compliance

This project complies with forest plan direction and the National Bald Eagle Management Guidelines (USFWS 2007).

California Spotted Owl: Affected Environment

Species and Habitat Account

The California spotted owl (*Strix occidentalis occidentalis*) is a Region 5 Forest Service Sensitive species and is also a Sierra Nevada Management Indicator Species (MIS). They are listed with the State of California as a Species of Special Concern. The California spotted owl occurs from the southern Cascades, throughout the Sierra Nevada in California and into Nevada, mountainous regions of southern California and the central Coast Ranges up to Monterey County (USDA 2001). They breed from 1,000 to 7,700 feet elevation. On the west slope of the Sierra Nevada, they use a wide range of habitat types and are considered year round residents (Ibid).

On December 23, 2014 a petition to list the California Spotted Owl was submitted to the USFWS. USFWS has not published information in the Federal Register to date and the USFWS website has identified this species as “under review” (USFWS 2015a). USFWS published their California spotted owl determination in the Federal Register Notice for Endangered and Threatened Wildlife and Plants; 90-Day Findings on 25 Petitions (USFWS 2015b): "Based on our review of the petitions and sources cited in the petitions, we find that the petitions present substantial scientific or commercial information indicating that the petitioned action may be warranted (emphasis added) for the California spotted owl (*Strix occidentalis occidentalis*) based on Factors A, D, and E. However, during our status review, we will thoroughly evaluate all potential threats to the species.” (USFWS 2015b, p. 56426). The USFWS review includes subjecting the petition to rigorous critical review, and soliciting additional information from parties outside the agency. This 90-Day finding does not change the status of this species.

The most recent population status and trend information can be found in Keane 2014, Conner et al. 2013, Tempel and Gutiérrez 2013, and Tempel et al. 2014. In summary, the most recent estimate of population size for California spotted owls in the Sierra Nevada reported 1865 owl sites, with 1399 sites on NFS lands. Ongoing research of recent population trends indicates increasing evidence for population declines on the three demographic study areas on NFS lands and a stable or increasing population on the National Park study area, (Conner et al. 2013, Tempel and Gutiérrez 2013, Tempel et al. 2014). The factors driving these population trends are not known (Keane 2014).

California spotted owl sites are identified through the use of protocol surveys (USDA March 12, 1991). Protocol surveys have been conducted throughout the Rim Fire area for the past two decades. These surveys are best described as opportunistic depending upon planned activities and funding levels but have occurred at a level such that inventory information for the analysis area is considered essentially complete.

The project action area is within the area of current distribution of spotted owls across the Sierra Nevada Bioregion. Currently, 44 spotted owl territories exist within the project area; this includes two new territories documented post-fire. LOPs will be placed around all documented spotted owl protected activity centers from March 1-August 15 of any given year during project implementation.

California spotted owls are top trophic-level avian predators associated with heterogeneous forests characterized by areas with large trees, large snags, and large down woody material (North et al. 2009, Roberts and North 2012, Keane 2014). General habitat requirements for spotted owls include forested environments with high canopy cover that feature vegetation types such as Montane Hardwood, Montane Hardwood Conifer, Ponderosa Pine, Douglas Fir, Sierran Mixed Conifer, and White Fir with trees in CWHR size classes 4 and 5 with greater than 40% canopy cover (CDFW 2008). The most valuable habitat has trees greater than 24 inches dbh and canopy cover greater than 70%. Approximately 50% of known owl sites are found in mixed conifer forest (USDA 2001). They prefer forested stands with complex vertical and horizontal vegetative structure. Recent research suggests that within their habitat matrix, spotted owls depend on “green” stands with the aforementioned characteristics for nesting, repeated roosting, and for foraging. Spotted owls use a broader range of vegetation conditions for foraging than they do for nesting and roosting (Ibid.), and this includes post-fire habitats as discussed below. Home range size for this species is highly variable and ranges from 2,500 acres on the Sierra National Forest, 4,700 acres on the Tahoe and Eldorado National Forests, and 9,000 acres on the Lassen National Forest (USDA 2001). About 39,957 acres of moderate to high capability habitat are within the analysis area. Suitable habitat has been greatly reduced in the heart of the analysis area and connectivity between large tracts of habitat on the forest and areas in Yosemite has been further reduced. This habitat fragmentation has reduced the probability of spotted owls accessing and utilizing all available habitat within the analysis area. Either natural regeneration recovery or forest management practices, such as planting, is needed to effectively reestablish connectivity and make suitable habitat readily available to spotted owls using this landscape. About 69,174 acres of moderate and high capability habitat are within the cumulative effects analysis area, including all ownerships.

Moderate to High Capability habitat is defined as that in which a CWHR suitability rating is greater than or equal to 0.55. Two of three categories (reproduction, cover, food) must have a medium rating to achieve the minimum rating. Reference CWHR version 8.2 users’ manual for further explanation on suitability ratings (CDFW 2008). Acres include NFS lands only.

Breeding typically occurs in late winter to spring and is dependent on elevation and weather conditions. USDA (2001) cites six studies that summarize spotted owl nesting and roosting habitat preferences:

- 70 to 95% total canopy cover at about 30 feet.
- Two or more canopy layers.

- Dominant and co-dominant trees in the canopy averaging at least 24 inches dbh.
- Total live basal area equal to 185 to 350 square feet per acre.
- Total snag basal area equal to 30 to55 square feet per acre.
- Higher than average levels of snags, at least 15 inches dbh and 20 feet tall.
- Downed woody debris averaging 10 to 15 tons per acre comprised of the largest logs.

Spotted owls use several different nest types; natural cavities in standing trees (live or dead), broken top trees and snags, platform nests created by other species, on debris accumulations, and dwarf mistletoe brooms (Ibid). Blakesley and others (2005) report nest tree sizes range from 14 to 86 inches dbh, with 90% of these greater than 30 inches dbh. Data from the Stanislaus show trees or snags ranging from 24 to 56 inches dbh have been selected as nest trees (USDA 2015).

Spotted owls consistently use forested stands with greater: canopy cover, total live basal tree area, basal area of hardwoods and conifers, snag basal area, and dead and downed wood, when compared to random locations (USDA 2001). Stands preferred by foraging owls consist of:

- At least 50 to 90% canopy cover at about 30 feet.
- At least two canopy layers.
- Dominant and co-dominant trees averaging at least 11 inches dbh.
- Total live tree basal area equal to 180 to 220 square feet per acre.
- Total basal area of snags equal to 15 to 30 square feet per acre.
- Higher than average levels of snags, at least 15 inches dbh and 20 feet tall.
- Downed woody debris averaging 10 to15 tons per acre, comprised of the largest logs.

Spotted owls typically hunt from elevated perches and will also hunt on the wing. Males will deliver food to nesting females, and both sexes cache excess prey for later consumption. The primary prey species at lower elevations are woodrats, and at higher elevations flying squirrels. They also prey upon gophers, bats, arthropods, and a variety of other rodents (CDFG 2008, Verner et al. 1992).

Spotted owls show the strongest associations with mature forest conditions for nesting and roosting but will forage in a broader range of vegetation types (Keane 2014). Recent research indicates that California spotted owls will occupy landscapes that experience low-to moderate-severity wildfire, as well as areas with mixed-severity wildfire that include some proportion of high-severity fire (Bond et al. 2009, Bond et al. 2010, Roberts et al. 2011, Lee et al. 2012, Bond et al. 2013, Lee et al. 2013). It is important to note that because of the overall size and severity of the Rim Fire, many owl sites in the Rim Fire had far larger proportions of core areas burned at high severity relative to any of these studies. How owls use habitat for foraging where high severity patch sizes are relatively large, and the relationship of owl use to the amount and arrangement of burned-unburned edge, among other factors needs further study (such as the research PSW currently being conducting within the Rim Fire area). In the closely related Northern spotted owl, Clark (2007) found that while spotted owls did roost and forage within high severity burn areas, the use was very low suggesting that this cover type was poor habitat for spotted owls. Clark et al. (2013) summarized the results provided by the few studies that have been conducted on spotted owls in burned landscapes and noted that results were equivocal. Eyes (2014) found that overall, California spotted owls avoided high severity forest patches and used lower severity patches, similar to Clark (2007). In summary, uncertainties remain regarding long-term occupancy and demographic performance of spotted owls at burned sites (Keane 2014). Specifically, uncertainty exists regarding how the amounts and patch sizes of high-severity fire will affect California spotted owl occupancy, demographics, and habitat over long time frames (Ibid). Spotted owls continue to occupy the project area, and are consistently located roosting and nesting in green forest including areas that burned at low to moderate severities, not in areas where high severity fire removed virtually all canopy cover.

Dispersal distances for spotted owls are not well studied. Northern spotted owl juveniles are expected to disperse at least eight miles (USDA 2001). A study of natal dispersal in an insular population in southern California documented male dispersal distances ranged from 1.4 to 22.6 miles and female dispersal distances ranged from 0.25 to 22 miles (Lahaye et al. 2001). Breeding dispersal probability was found higher in younger owls, single owls, paired owls that lost their mates, owls at lower quality sites, and owls that failed to reproduce in the year preceding dispersal (Blakesley et al. 2006). Dispersal distances were similar in both males and females and ranged from 0.62 to 20.5 miles (Ibid). Spotted owls are not migratory but may move down slope to lower elevations during winter months.

RISK FACTORS

USFWS (2006) and USDA (2001 and 2004) summarized risk factors potentially influencing California spotted owl distribution and abundance:

1. *Habitat Loss*: USFWS determined the primary threat to spotted owls is loss of habitat to high-severity wildfire that has resulted from fire suppression and past fire management policy. Habitat loss or modification from vegetation management and effects to the distribution, abundance and quality of habitat are also a concern. Logging since the turn of the century has resulted in a reduction in the amount and distribution of mature and older forests and specific habitat elements such as large trees, snags, and downed logs, used for nesting and foraging by California spotted owls.
2. *Habitat Fragmentation*: This is of particular concern on the Stanislaus because large inclusions of non-federal lands pose uncertainty associated with maintaining a well-distributed spotted owl population.
3. *Climate Change*: Climatic changes resulting in wetter winters and springs can affect spotted owl reproductive output.
4. *Breeding Habitat Disturbance*: Disturbance from recreation activities may interfere with owl fitness and nesting success.
5. *Barred Owl*: Expansion of barred owls has resulted in the introduction of a generalist species into the range of the spotted owl, a specialist species. The barred owl is considered a competitor for nesting habitat with the spotted owl and can also hybridize with the spotted owl (Dark et al. 1998). No barred owls have been detected on the Stanislaus, but they do occur on the Eldorado National Forest to the north, and the Sequoia National Forest to the south.
6. *Disease*: The effect of West Nile virus on owl populations is uncertain at this time because the disease was only recently detected in Tuolumne County (summer 2004). Given the mortality rates in similar avian species that have contracted West Nile Virus, a high mortality rate could be expected in infected spotted owls.

California Spotted Owl: Environmental Consequences

The project alternatives could result in direct and indirect effects to the California spotted owl through the following activities:

- Mechanical site preparation for planting.
- Herbicide application for site preparation and release of conifers.
- Planting and thinning conifers.
- These direct and indirect effects include: Project related death, injury and disturbance.
- Project related modifications to habitat quantity and/or quality.

Death, Injury and Disturbance

Death, injury and disturbance are potential direct effects to consider for spotted owl (USDA 2004). Project activities have the potential to cause death or injury by tree-falling or by the use of heavy equipment. There is the potential for death or injury if nest trees are felled while being used by nesting birds during the reproductive season. The mobility of the species in question and the management requirement of LOPs, make it highly improbable that death or injury would occur as a result of project activities.

Project activities have the potential to cause disturbance through the use of loud machinery. Loud noise from equipment such as dozers, masticators, chain saws and even large crews of people on site at one time is expected throughout project implementation.. Loud noise has the potential to change normal behavior patterns during the period operations would take place and could potentially impair essential behavior patterns of the spotted owl related to breeding, feeding or sheltering. The potential for disturbance to breeding owls is minimized by the implementation of LOPs.

Habitat Modification

California spotted owls are most closely associated with heterogeneous forests characterized by areas with large trees, large snags, and large down woody material (North et al. 2009, Roberts and North 2012, Keane 2014). They prefer forested stands with complex vertical and horizontal vegetative structure. Research from the past several decades continues to suggest that within their habitat matrix, spotted owls depend on “green” stands with the aforementioned characteristics for nesting, repeated roosting, and for foraging. Habitat loss and fragmentation are known to be risk factors affecting spotted owl persistence across their range in the Sierra Nevada (USFWS 2006c). Research indicates that successful territories (i.e., sustained survival and occupancy) have more than 300 acres of high quality forested habitat comprised of canopy cover greater than 70% (Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands, USDA 2015f). Additionally, territories with greater concentrations of forested habitat with canopy cover greater than 50% in close proximity to the nesting area exhibit higher occupancy rates and lower extinction rates (Ibid). Green forest remains present within spotted owl territories providing nesting, roosting, and foraging habitat; however, this habitat has become fragmented to varying degrees as a result of the Rim Fire. Reestablishing forested habitat in close proximity to the remaining green forest, increasing habitat availability and reducing fragmentation across would improve territory and landscape level habitat conditions for spotted owls. Built in design criteria would promote heterogeneity when planting or pre-commercially thinning conifers. For example, up to 5 oaks per acre would receive a 25 foot radius buffer to provide ample growing space in the long-term. Up to 20% understory vegetative cover would be retained on a unit basis and would not be treated during site preparation or release. Other inoperable areas, such as steep pitches and sensitive plant sites would not be planted with conifers. These design criteria would break up the continuity of planted conifers, promote several open grown oaks per acre and would provide understory vegetation throughout the treated areas. Active or managed reforestation is predicted to provide more complex habitat conditions in the long-term. For, example, active reforestation is expected to produce more large trees (e.g., greater than or equal to 24 inches dbh) and higher levels of snag recruitment when compared to the No Action Alternative. Restoring fire to this landscape within ten years of planting treatments, as proposed under Alternatives 1 and 3, would contribute to stand and landscape heterogeneity and structure and promote resiliency across forested areas as described in the desired conditions for open canopy mosaic and old forest emphasis. Thinning new plantations, as proposed under Alternative 5, would contribute to achieving stand and landscape heterogeneity described as ICO in the desired condition for open canopy mosaic and old forest emphasis. Thinning existing plantations is also expected to accelerate growth rates and increase structural stand diversity, improving roosting, nesting and foraging habitat conditions sooner than without thinning. Thinning these areas would also increase resilience to future fire (3.05 Fuels). Reforestation and thinning efforts would promote the viability of spotted owls across this landscape in the short and long-term.

Short-term, within the next ten years, snags and down woody material will function as habitat elements important for owl prey. Snags also serve as potential hunting perch sites that may be utilized by foraging owls. Recent research indicates that prey species may be abundant and available in the post-fire environment. Work by Bond et al. (2009, 2013) indicates that owls may use high-severity fire areas for foraging and that foraging owls with burned forest in their home range appear to utilize a variety of prey. Results from studies of small mammal habitat associations demonstrate the species-specific importance of habitat elements such as shrubs, downed logs, snags, and truffles (Keane 2014). The time elapsed since fire is closely correlated with habitat elements and the composition of prey species (Roberts 2008, Roberts and van Wagtendonk 2008). For example, post-fire habitats are typically rich in gophers and deer mice in the first decade following a fire, followed by wood rats when understory conditions are well developed in the first and following decades and finally by sciurid squirrels and flying squirrels when trees reach maturity (Ingles 1965, Quinn and Keeley 2006). A diversity of prey species within a habitat mosaic can be expected to benefit predators such as the spotted owl (Roberts and North 2012). Retention of burned habitat within PACs and areas not proposed for reforestation would provide habitat for prey that may in turn benefit resident owls. While research (such as that currently underway in the Rim Fire area) will help better determine retention thresholds and spatial arrangements of snags compatible with owl use, snag retention of 12 to 30 square feet basal area per acre proposed under all action alternatives is likely to allow for an adequate number of perch sites for owl foraging within and adjacent to treatment units.

Long-term over several decades, large snags and large down logs are considered biological legacies in the post-fire environment and play important roles in the structure of the future forest (Lindenmayer et al. 2008). For example, large snags and large down logs are fundamental to the definition of old forest and are important attributes for the development of the old forest ecosystem and associated species such as the spotted owl. Snags may stand for decades and in time, may become future nest trees for spotted owl as the regenerating forest nears maturity, although few large snags may be expected to remain intact by that time. Snag dynamics in the Sierra Nevada are complex and snags fall at different rates depending on many factors (Cluck and Smith 2007). Once recruited into the down woody material on the ground, this coarse woody debris again serves as an important element in owl habitat (Verner et al. 1992). Thus, decaying wood serves different functional roles overtime, first providing cover for spotted owl prey in the complex early seral stage of the forest, and ultimately decaying and playing a critical role in soil development of old forests. For example, logs in decay class five (i.e. highly decayed) are associated with hypogeous fungi (i.e. truffles), which in turn serve as a primary food source for spotted owl prey in old forests - the flying squirrel in particular (Verner et al. 1992).

Spotted owls use habitat at multiple scales ranging from breeding territories that are several hundred acres, home ranges that are several thousand acres, to landscapes when considering population viability. Because spotted owls focus their breeding activities in the best available habitat around roost and nest sites (Verner et al. 1992), habitat modification effects are expected to be most pronounced in PACs (at least 300 acres) and Home Range Core Areas (HRCAs) (700 acres adjacent to PACs).

Indicators

The following indicators were chosen to provide a relative measure of the direct and indirect effects to the spotted owl and to determine how well project alternatives comply with Forest Plan Direction.

1. Acres of future moderate and high capability habitat planted and thinned.
2. Toxicological effects from herbicide use.

These criteria were chosen based on the best available scientific literature which focuses on various aspects of spotted owl ecology and life history requirements. These criteria focus on those life history aspects, or habitat elements, considered most limiting to California spotted owl persistence across their range and where project effects are expected.

Alternatives 1, 3 and 5

Because there is little difference in the planting prescription and outcome in the short and long-term under these three alternatives, the effects are expected to be similar and are analyzed together. The difference in herbicide proposed between Alternatives 1 and 5 versus Alternative 3 were separated below accordingly.

DIRECT AND INDIRECT EFFECTS

Indicator 1, PACs

Reforestation and Natural Regeneration

Under Alternatives 1, 3 and 5, eight PACs exist where reforestation is proposed on about 98 acres where hazard trees were removed post Rim Fire; Ackerson Creek, Ackerson Mountain, MF Tuolumne, Cottonwood Creek, and Lower Skunk Creek. Table 3.16-6 displays the affected territories, proposed treatments, desired conditions, and associated acres; maps are available in the Terrestrial Wildlife BA/BE, Appendix A. No treatments are proposed within 500 feet of current activity centers. Reforesting these areas would provide screening from the roads and restore the amount of interior habitat that was available to resident owls pre-fire. Because of the limited acreage involved in these treatments, minor benefits are expected for resident owls.

Three PACs exist where reforestation is proposed on about 89 acres that burned at higher severity to enhance and protect sensitive plant habitat and Watchlist species of interest habitat; Femmons, South Fork Tuolumne, and Soldier Creek (Table 3.16-6). No treatments are proposed within 500 feet of current activity centers. These areas are known to be occupied by these sensitive and unique plant species and local populations would benefit from proposed treatments (3.09 Sensitive Plants). The Region 5 sensitive plants are Mountain ladyslipper and Goward's waterfan, and the botanical species of interest is madrone. Small fire killed trees less than 15 inches dbh would be removed to reduce fuel loading and increase safety for workers when planting conifers. All trees, live and dead, greater than 15 inches dbh within these planting areas would be retained and would continue to provide perch, roost, and potential nest sites for owls. Oaks would be buffered similar to other planting prescriptions under these alternatives. All madrones would be buffered by 25 feet during planting. Owls are also expected to realize minor benefits from these proposed treatments. Most notably, increased within stand structure and diversity comprised of uneven aged forest.

Table 3.16-6 Alternatives 1, 3 and 5: Spotted Owl PAC Acres by Treatments and Desired Condition

Spotted Owl PAC and ID	Reforestation[1] in OFM	Reforestation[1] in OCM	Thin in OFM	Totals
Soldier Creek TUO0010	42	0	0	**42**
Ackerson Creek TUO0012	0	17	0	**17**
SF Tuolumne TUO0024	21	0	0	**21**
MF Spinning Wheel TUO0025	0	0	68	**68**
Ackerson Mtn TUO0039	0	16	0	**16**
MF Tuolumne TUO0040	0	21	0	**21**
Femmons Meadow TUO0072	26	0	0	**26**
Cottonwood Creek TUO0149	0	27	0	**27**
Lower Skunk Creek TUO0218	17	0	0	**17**
Totals	**106**	**81**	**68**	**255**

PAC=Protected Activity Center; OFM=Old Forest Mosaic; OCM=Open Canopy Mosaic
[1] Includes natural regeneration

Thinning

One PAC proposes thinning of existing plantations on about 68 acres; South Fork Tuolumne (Table 3.16-6). Three distinct plantations comprised of trees ranging in size from 10 to 20 inches dbh are located within this PAC. Thinning of plantations is designed to promote increased vertical and horizontal structure, release oaks, breaking up the continuity of vegetation and increasing resilience when fire returns. Thinning existing plantations in this PAC would increase the growth rate of remaining trees and promote understory herbaceous and woody vegetation recruitment. The expected increase in stand diversity coupled with snag retention would provide higher quality habitat for owls and important prey species such as mice and squirrels in the short-term.

Indicator 1, HRCAs

Reforestation and Natural Regeneration

About 4,793 acres are within 28 HRCAs proposed for reforestation. Table 3.16-7 displays the affected territories, proposed treatments, desired conditions, and associated acres. Planting areas adjacent to and near spotted owl activity centers as proposed under these alternatives would more quickly improve breeding habitat conditions for resident birds. The HRCA acres proposed for reforestation were mostly burned at high severity, reducing the amount of green forested habitat available in close proximity to the owl's activity centers.

Thinning

About 983 acres are within 16 HRCAs proposed for thinning of existing plantations (Table 3.16-7). While some of these plantations are considered suitable because they are CWHR size class 4 or 5 and have greater than 40% canopy cover, they lack structural diversity. Thinning these plantations would promote vertical and horizontal diversity which in turn improves habitat capability. Prescribed fire would be the first tool used for thinning these stands. The goal in using prescribed fire is to open up these stands, creating a habitat mosaic with individual trees, clumps of trees, and openings. If we are unable to accomplish thinning by using prescribed fire, we would use mechanical means to achieve the desired conditions in these plantations. Mechanical thinning prescriptions for these plantations focus on using an Individual, Clumps, and Openings (ICO) design that would provide structural diversity where it doesn't currently exist. For example, the prescription calls for releasing oaks and creating groups of trees separated by openings. After thinning, remaining trees are expected to grow faster and understory vegetation would become established, improving habitat conditions for owls and their prey in the short and long-term. Also, by breaking up the continuity of vegetation across a given area, the habitat would be more resilient when fire or other stochastic events occur.

Spotted owls are expected to benefit in the short and long-term from reforestation and thinning treatments. Reforestation and thinning as proposed under Alternatives 1, 3 and 5 would improve habitat conditions and increase the amount of moderate and high capability habitat available within these territories, moving them toward the desired condition outlined in the Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands (USDA 2015).

Greater Landscape

Under these alternatives, an additional 21,650 acres are proposed for reforestation (reforestation and natural regeneration) across the project area. The reforestation treatments when combined with reforestation in PACs and HRCAs would increase the amount of moderate and high capability habitat available to owls on NFS lands by 67% in the long-term. Under these alternatives, an additional 13,000 acres of thinning existing plantations occur across the project area. The reforestation and thinning treatments proposed under these alternatives have the potential to benefit spotted owls at the landscape scale. These alternatives would result in the greatest increase of moderate and high capability forested habitat across this landscape. Because habitat loss and fragmentation have been identified as a significant risk to spotted owl persistence across their range, reestablishing forest habitat across the landscape is critical. Reduced fragmentation and increased availability of suitable habitat is expected to benefit resident and dispersing spotted owls.

Table 3.16-7 Alternatives 1, 3 and 5: Spotted Owl HRCA Acres by Treatment and Desired Condition

HRCA and ID	Reforestation in OFM[1,2]	Reforestation in OCM[1,2]	Thin[1] in OFM	Thin[1] in OCM	Total Acres[1]	% HRCA[1] Treated
Cherry Lake HRCA TUO0AAA	0	2	91	69	163	16
Mather HRCA TUO0BBB	52	163	3	2	220	20
Soldier Creek HRCA TUO0010	251	120	0	0	371	37
Big Creek HRCA TUO0011	87	65	0	36	187	18
Ackerson Creek HRCA TUO0012	5	58	0	0	64	6
SF Tuolumne HRCA TUO0024	239	234	0	0	474	47
MF Spinning Wheel HRCA TUO0025	56	148	71	75	349	35
Rush Creek HRCA TUO0026	112	104	0	0	218	22
North Bear Mtn HRCA TUO0027	150	152	0	21	323	26
Bear Mtn HRCA TUO0028	183	222	0	28	432	43
Reed Creek HRCA TUO0031	143	550	6	0	699	70
Ackerson Mtn HRCA TUO0039	47	58	0	0	106	10
MF Tuolumne HRCA TUO0040	52	163	3	2	220	20
Bear Spring Creek HRCA TUO0061	13	15	30	0	58	5
Spotted Owl HRCA TUO0065	0	4	0	37	41	4
Femmons Mdw HRCA TUO0072	44	48	0	0	175	17
Crocker Mdw HRCA TUO0078	18	53	0	3	73	5
Harden Flat NW HRCA TUO0085	129	272	0	0	401	39
Bear Creek HRCA TUO0145	0	18	0	71	89	9
Hunter Creek HRCA TUO0146	0	90	0	247	337	34
Cottonwood Creek HRCA TUO0149	0	135	0	84	219	22
Ascension Mdw W HRCA TUO0177	18	56	5	12	90	9
N Niagara HRCA TUO0205	0	18	0	16	34	3
L Skunk Creek HRCA TUO0218	386	153	0	0	539	5
U Cherry Lake HRCA TUO0219	17	0	57	6	80	8
Box Spring HRCA TUO0255	0	27	0	4	31	3
Spotted Owl HRCA TUO0257	0	33	0	0	33	3
Spotted Owl HRCA TUO0258	0	44	0	0	44	4
Total HRCA Acres	**1,950**	**2,844**	**263**	**720**	**5,777**	

HRCA=Habitat Conservation Area; OFM=Old Forest Mosaic; OCM=Open Canopy Mosaic
[1] Includes PAC treatment acres
[2] Includes Natural Regeneration

Indicator 2

Under Alternatives 1 and 5, herbicide use is expected to have a limited potential for direct or indirect toxicological effects on spotted owls, as described under the herbicide risk assessment section. Because no herbicides are proposed under Alternative 3, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to spotted owls would occur under this alternative.

CUMULATIVE EFFECTS

Appendix B identifies the present and reasonably foreseeable future actions on all lands within the analysis area. Some, but not all of these actions have or may contribute cumulatively to effects on spotted owls.

Based on risk factors affecting spotted owl abundance and distribution, the following evaluation criteria were used as relative measures of cumulative effects from Alternatives 1, 3 and 5: habitat modification. In addition, Alternatives 1 and 5 used toxicological effects for evaluation criteria.

Habitat Modification

Federal Lands

Present and foreseeable future activities on federal lands include: Funky Stewardship, Groovy Stewardship, Reynolds Creek Stewardship, Soldier Creek Timber Sale, Campy Timber Sale, Looney Timber Sale, Thommy Timber Sale, which are green thinning projects treating 6,100 acres of green forest across the analysis area. All snags and many declining trees will be retained unless they pose a safety hazard in these projects. The snag and declining tree retention will provide snags that could serve as potential roost or nest sites for spotted owls in the short-term as well as recruits for future nest sites in the long-term. Other federal activities potentially impacting breeding habitat for spotted owls is fuels reduction associated with the Rim Recovery project. Fuels reduction associated with this project will reduce the risk of further loss of remaining green forest within the project area.

Toxicological Effects

Federal Lands

There is one present federal action of herbicide use on 0.5 acres under the Rim Fire Rehabilitation project and two foreseeable federal actions of herbicide use: 8.0 acres under the Twomile Ecological Restoration Noxious Weed project and 23 acres under a special use permit for the Reliable Power Project powerline. No other present or foreseeable future federal actions are related to herbicide use.

Private Lands

Herbicide use is proposed on 1,583 acres of private land within the project area in 2017. No other present or foreseeable future actions are proposed on private lands related to herbicide application.

Alternatives 1, 3 and 5 Contribution and Summary

Alternatives 1, 3 and 5 would contribute cumulatively to short and long-term effects to California spotted owls. Under these alternatives, reforestation on about 26,400 acres would increase the amount of moderate and high capability habitat available across the analysis area by 38% in the long-term. Thinning about 14,000 acres of existing plantation is also expected to benefit spotted owls. These alternatives would result in similar benefits with respect to existing plantation thinning when compared to Alternative 4 because the thinning prescription is the same under all action alternatives. However, under Alternatives 1, 3 and 5, the reforestation treatments would complement the thinning to improve habitat conditions across the landscape. Alternatives 1 and 5 would contribute to the short-term limited potential of exposure to toxicity from herbicide use. Alternatives 1, 3 and 5 would result in the greatest increase in available habitat and connectivity at the territory and landscape scale when compared to Alternatives 2 and 4. The cumulative contribution under this alternative is expected to benefit resident and dispersing California spotted owls and may beneficially affect the viability of this species.

Alternative 2

DIRECT AND INDIRECT EFFECTS

Indicator 1

The indirect effects of no action are primarily related to the influence no action may have on the amount of moderate and high capability habitat available, the restoration of habitat connectivity across the landscape, and how that may impact California spotted owls in the long-term. Under this alternative, about 9,800 acres of forested habitat is predicted to develop naturally with no active management across the landscape. This would increase habitat availability across NFS lands by 25%, almost 42%less than that expected under Alternatives 1, 3 and 5. Because no active management would occur, it is unknown where naturally regenerating forest would occur and what benefits that would provide spotted owls. It is likely that areas in close proximity to live trees (i.e. seed source) would experience forest expansion to a limited degree, depending on the competing vegetation in the localized area. It should be noted that natural conifer expansion is sporadic in nature, could be delayed for decades due to shrub suppression, would likely be dominated by fir, and would not result in significant gains in forested habitat (3.13 Vegetation). Areas far from seed sources would likely persist as chaparral for decades if not well over a hundred years. Existing plantations would not be thinned under this alternative; therefore, increasing structural diversity and improving habitat quality in these areas would not be realized. The plantations, if left untreated, could be at greater risk of loss when fire returns to this landscape because of the tightly spaced live trees and fuel loading from fire mortality (3.05 Fuels).

Indicator 2

Because no herbicides are proposed under Alternative 2, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to spotted owls would occur under this alternative.

Cumulative Effects

The cumulative effects discussion under Alternatives 1, 3 and 5 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 2 Contribution and Summary

Under Alternative 2, no direct cumulative effect is expected because no active management would occur, however, there may be indirect consequences under this alternative primarily related to the influence no action may have on future forest development and how that may impact California spotted owls. At the landscape scale, the cumulative contribution under this alternative would increase the available suitable habitat by 14% (9,800 acres) compared to a 38% increase (26,400 acres) under Alternatives 1, 3 and 5. It is unknown where and how long it would take natural regeneration to occur and what, if any, benefits would be realized by spotted owls at the territory or landscape level. The cumulative contribution under this alternative may negatively affect individuals and would not result in beneficial effects to the viability of this species.

Alternative 4

Direct and Indirect Effects

Indicator 1, PACs

Reforestation and Natural Regeneration

Under Alternative 4, five PACs with up to 23 acres are proposed for reforestation. Effects from these limited proposed treatments are not measureable and are considered negligible or discountable.

Thinning

There is one PAC where thinning of existing plantations on about 68 acres is proposed; South Fork Tuolumne. The thinning prescriptions and expected benefits are the same as those discussed under Alternatives 1, 3 and 5.

Indicator 1, HRCAs

Reforestation and Natural Regeneration

About 820 acres are within 14 HRCAs proposed for reforestation. This is about 4,000 acres less than Alternatives 1, 3 and 5. Table 3.16-8 displays the affected territories, proposed treatments, desired conditions, and associated acres. The planting prescription under this alternative is termed founder stands. This prescription calls for small variable shaped planting areas ranging from two to ten acres in size within a larger unplanted area. The unplanted area would likely be comprised of chaparral with scattered oaks. The planted area is only 20% of a given unit. Herbicides would be used to control shrubs and competing vegetation within planted areas and incorporating a 25 to 50 foot buffer around planted areas. These trees would be planted with a much tighter spacing, groups of 5 trees spaced 6 feet from each other. With the tighter spacing of planted trees, it may be necessary to thin the plantations around year 7 to allow growing space for the trees to mature. Prescribed fire or hand tools would be used to thin the new plantations. Prescribed fire would be applied to 50% of planted areas within ten years and the other 50% within 20 years. Reforesting in this manner would result in several small fragmented patches of forested habitat no bigger than ten acres separated by large tracts of chaparral. Small patches of forested habitat covering 20% of a given area would not provide the moderate and high capability habitat required by breeding spotted owls, which include large areas of contiguous forest.

Table 3.16-8 Alternative 4: Spotted owl HRCA Acres by Treatment and Desired Condition

HRCA and ID	Reforestation in OFM[1,2]	Reforestation in OCM[1,2]	Thin[1] in OFM	Thin[1] in OCM	Total Acres[1]	% HRCA[1] Treated
Cherry Lake HRCA TUO0AAA	0	0	91	69	161	16
Soldier Creek HRCA TUO0010	89	24	0	0	113	11
Big Creek HRCA TUO0011	40	5	0	36	80	8
SF Tuolumne HRCA TUO0024	98	48	0	0	148	15
MF Spinning Wheel HRCA TUO0025	12	21	71	75	178	18
Rush Creek HRCA TUO0026	16	30	0	0	46	5
North Bear Mtn HRCA TUO0027	24	12	0	21	57	6
Bear Mtn HRCA TUO0028	38	42	0	28	109	12
Reed Creek HRCA TUO0031	15	98	6	0	119	12
MF Tuolumne HRCA TUO0040	4	16	3	2	25	2
Bear Spring Creek HRCA TUO0061	3	10	30	0	42	7
Spotted Owl HRCA TUO0065	0	0	0	37	37	8
Bear Creek HRCA TUO0145	0	0	0	71	71	16
Hunter Creek HRCA TUO0146	0	0	0	247	247	25
Cottonwood Creek HRCA TUO0149	0	0	0	84	84	18
Ascension Mdw W HRCA TUO0177	17	6	5	12	41	6
N Niagara HRCA TUO0205	0	0	0	16	16	11
Lower Skunk Creek HRCA TUO0218	70	25	0	0	95	9
U Cherry Lake TUO0219	0	0	57	6	63	6
Box Spring HRCA TUO0255	0	28	0	4	32	3
Westside West HRCA TUO0258	0	28	0	0	28	3
Total HRCA Acres	**426**	**394**	**263**	**709**	**1792**	

[1] Includes PAC treatment acres
[2] Includes Natural Regeneration

Similar to the No Action Alternative, about 9,800 acres of forested habitat is predicted to develop naturally with no active management across the landscape. Because no active management would occur on these acres, it is unknown where naturally regenerating forest would occur and what benefits it would provide for spotted owls. It is likely that areas in close proximity to live trees (i.e. seed source) would experience forest expansion to a limited degree, depending on the competing vegetation in the localized area. As stated under the No Action Alternative, natural conifer expansion is sporadic, could be delayed for decades due to shrub suppression, would likely be dominated by fir, and would not result in significant gains in forested habitat (3.13 Vegetation). Areas far from seed sources would likely persist as chaparral for decades if not well over a hundred years. While this alternative would increase the amount of forested habitat across NFS lands by up to 25%, it is unknown how fragmented or contiguous the distribution would be across the landscape and if it would provide benefits to spotted owls at the territory or landscape scale.

Thinning

About 973 acres within 16 HRCAs are proposed for thinning of existing plantations. Because the prescription for thinning is the same for all action alternatives, benefits are expected to be the same as discussed under Alternatives 1, 3 and 5.

Spotted owls are expected to benefit in the short and long-term from thinning treatments. Reforestation as proposed under Alternative 4, small isolated patches of forest no larger than ten acres in size, is not likely to improve habitat conditions or increase the amount of moderate and high capability habitat available within these territories. It is unknown if spotted owls would benefit from natural regeneration, but it is expected to take much longer for suitable breeding habitat to develop across these territories under this Alternative.

Greater Landscape

Under this alternative, an additional 2,107 acres proposed for reforestation (reforestation and natural regeneration) exist across the project area. These treatments are not likely to benefit spotted owls because reforestation would result in small fragmented patches of forest no larger than ten acres in size separated by large tracts of chaparral. About 13,000 additional acres of existing plantation are proposed for thinning. These thinning treatments are likely to benefit spotted owls in the short and long-term. This alternative would result in the least amount of moderate and high capability forested habitat and the lowest reduction in habitat fragmentation when compared to Alternatives 1, 3 and 5.

Indicator 2

Herbicide use is expected to have a limited potential for direct or indirect toxicological effects on spotted owls, as described under the herbicide risk assessment section.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 4 Contribution and Summary

Alternative 4 would contribute cumulatively to short and long-term effects to northern spotted owls. Under this alternative, reforestation on up to 2,950 acres in discreet patches no larger than ten acres is not expected to result in benefits to spotted owls. Natural forest recovery under this alternative is expected to increase available habitat by up to 14% across the analysis area. However, this natural forest recovery is expected to be sporadic, delayed, and a limited contribution to moderate and high capability habitat in the long-term. The founder stands prescription is not expected to provide moderate and high capability habitat because it would be located in small fragmented patches separated by large tracts of chaparral. Under this alternative about 14,000 acres of existing plantation would be thinned, promoting structural diversity and improving habitat capability in the short and long-term. This alternative would result in similar benefits with respect to existing plantation thinning when compared to Alternatives 1, 3 and 5 because the thinning prescription is the same under all action alternatives. Alternative 4 would contribute to the short-term limited potential of exposure to toxicity from herbicide use. The cumulative contribution under this alternative is expected to provide limited benefits to resident or dispersing spotted owls and would not result in beneficial effects to the viability of this species.

California Spotted Owl: Summary of Effects

Indicator 1

Table 3.16-9 shows the number of acres proposed for planting and the number of acres of existing plantation proposed for thinning at the PAC, HRCA and landscape scales. Alternatives 1, 3 and 5 would provide the greatest amount of moderate and high capability habitat for spotted owls in the long-term when compared to Alternative 4. All action alternatives would result in the same amount of future moderate and high capability habitat within the treated existing plantations; however, Alternative 4 does not complement the existing plantation treatments by accelerating forest reestablishment in adjacent areas or across the landscape as proposed under Alternatives 1, 3 and 5.

Indicator 2

Herbicide use under Alternatives 1, 4 and 5 are expected to have limited potential for direct or indirect toxicological effects on spotted owls. Because Alternative 4 has fewer proposed acres of herbicide application, the potential for effects would be less than under Alternatives 1 and 5. However, it is important to note that the toxicity exposure scenarios analyzed in the risk assessment show that all HQs are several orders of magnitude less than the NOAEL; therefore, spotted owls are provided an adequate margin of safety in the event that they are exposed to contaminated prey or water.

Table 3.16-9 California Spotted Owl Summary of Effects: Future Moderate to High Capability Habitat

Metric	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Acres reforested in PACs[1]	187	0	187	23	187
Acres reforested in HRCAs[1]	4,793	0	4,793	820	4,793
Acres reforested (landscape)[1]	21,650	0	21,650	2,107	21,650
Total reforested acres	**26,630**	**0**	**26,630**	**2,950**	**26,630**
Acres of existing plantation thinned in PACs	68	0	68	68	68
Acres of existing plantation thinned in HRCAs	983	0	983	983	983
Acres of existing plantation thinned (landscape)	13,000	0	13,000	13,000	13,000
Total thinned acres	**14,051**	**0**	**14,051**	**14,051**	**14,051**

[1] Includes natural regeneration.

DETERMINATIONS

Alternatives 1 and 5

Alternatives 1 and 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. This determination is based on the following rationale:

- These alternatives include actions to reestablish contiguous forested habitat, accelerating the time in which these areas would be suitable for nesting, roosting and foraging.
- These alternatives include actions to thin existing plantations, accelerating the time in which these areas would be suitable for nesting, roosting and foraging.
- Habitat connectivity would be restored under these alternatives.
- Snag retention in close proximity to green forest would result in maintaining roosting and nesting structures as well as habitat for prey throughout the treated areas.
- These alternatives require the use of LOPs to reduce disturbance potential to breeding spotted owls.
- These alternatives provide for surveys to establish or confirm the location of activity centers and boundaries.
- Toxicity exposure levels from herbicide use under these alternatives are all several orders of magnitude below the Forest Service established threshold of concern.

Alternative 2

Alternative 2 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the California spotted owl. This determination is based on the following rationale:

- This alternative would result in the smallest increase in moderate to high capability habitat available to spotted owls in the long-term.

- The structural diversity of existing plantations would not be enhanced and thus habitat quality would not be improved in the short or long-term.
- Untreated existing plantations may be at greater risk of loss when fire returns to this landscape.
- There would be no potential for exposure to herbicides.

Alternative 3

Alternative 3 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the California spotted owl. This determination is based on the following rationale:

- This alternative includes actions to reestablish contiguous forested habitat, accelerating the time in which these areas would be suitable for nesting, roosting and foraging.
- This alternative includes actions to thin existing plantations, accelerating the time in which these areas would be suitable for nesting, roosting and foraging.
- Habitat connectivity would be restored under this alternative.
- Snag retention in close proximity to green forest would result in maintaining roosting and nesting structures as well as habitat for prey throughout the treated areas.
- This alternative requires the use of LOPs to reduce disturbance potential to breeding spotted owls.
- This alternative provides for surveys to establish or confirm the location of activity centers and boundaries.
- There would be no potential for exposure to herbicides.

Alternative 4

Alternative 4 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the California spotted owl. This determination is based on the following rationale:

- This alternative includes actions to establish small fragmented patches of forest that would not provide suitable nesting or roosting habitat.
- This alternative includes actions to thin existing plantations, accelerating the time in which these areas would be suitable for nesting, roosting, and foraging.
- Snag retention in close proximity to green forest would result in maintaining roosting and nesting structures as well as habitat for prey throughout the treated areas.
- This alternative requires the use of LOPs to reduce disturbance potential to breeding spotted owls.
- This alternative provides for surveys to establish or confirm the location of activity centers and boundaries.
- Toxicity exposure levels from herbicide use under this alternative are all several orders of magnitude below the Forest Service established threshold of concern.

California Spotted Owl: Consistency with Draft Interim Recommendations for the Management of California Spotted Owl Habitat on NFS Lands

Applicable Interim Recommendations

Region 5 is in the process of developing a new conservation strategy for the California spotted owl throughout its range in California. The Conservation Assessment is near completion, and it is intended to serve as the primary scientific foundation for the Conservation Strategy, which Region 5 anticipates to be completed by March 31, 2016. In the intervening time period, the Region asked the leading experts in the California spotted owl, forest ecology and fire ecology in the Sierra Nevada associated with the Conservation Assessment to provide interim recommendations on changes to forest management prior to the development of the Conservation Strategy.

CONSERVATION MEASURES

The following applicable conservation measures are listed in the Draft interim recommendations for the management of California spotted owl habitat on National Forest System Lands (USDA 2015b):

1a. Recommendation that habitat conservation for California spotted owls should be addressed at four scales – activity center, territory, home range and landscape.

2b. Recommendation that target canopy cover conditions for PAC habitat be set at greater than or equal to 70%. Further, it is recommend that all snags, 15 inches and above, be retained in PACs, unless they represent a safety hazard.

3d. Designated habitat patches or stands ideally are large enough to provide interior stand conditions (1 to 2 tree heights from edge) to minimize edge effects, particularly for the acres with greater than or equal to 70% canopy cover.

4d. Desired conditions for a 1,000-acre territory are the following:

- Greater than or equal to 40% (400 acres) with greater than 70% canopy cover (or best available – see recommendation 3b).
- Additional minimum of 300 acres (30%) with greater than 50% canopy cover.
- The remaining area (less than 300 acres) should represent fine-scale mosaic (gaps and patches of 0.03 to 2.0 acres) of low, moderate and high canopy cover that create heterogeneous conditions and are in turn conducive to supporting suitable foraging habitat and an abundance of prey.
- The condition of the territory is a function of all lands that occur within the territory.

5d. Recommendation that the area outside the territory circle and within any given home range area be managed to maintain an average of 40% canopy cover across the entire home range area (not at the stand scale), with conditions ranging from less than 25% to less than 70% canopy cover across a fine-scale mosaic of heterogeneous conditions. The average condition is intended to serve as a guide in balancing a wide range of stand-scale canopy cover conditions across the home range area toward creating heterogeneous forest conditions.

Interim Guidance Consistency

The action Alternatives 1, 3, 4 and 5 demonstrate Interim Recommendation Consistency through the following:

Alternatives 1, 3, 4 and 5 address spotted owl habitat conservation at the activity center, territory and landscape scale.

Alternatives 1, 3 and 5 retain all snags greater than 15 inches dbh within PACs, unless they represent a safety hazard.

Alternatives 1, 3 and 5 would provide habitat patches and stands that provide interior stand conditions to minimize edge effects.

Alternative 4 would not consistently provide interior habitat patches or stands in close proximity to each other. The fragmented nature of the founder stands would likely present a barrier to spotted owl use of small forested patches and movement across non-forested areas to reach other small forested patches.

Alternatives 1, 3 and 5 address and propose actions that would result in moving spotted owl territories and the greater landscape toward desired conditions identified in the interim recommendations in the long-term, specifically conservation measures 3d and 4d.

Alternative 4 does not address or propose actions to address conservation measures 3d or 4d.

Great Gray Owl: Affected Environment

Species and Habitat Account

The great gray owl (*Strix nebulosa*) is a Region 5 Forest Service Sensitive species and is listed as Endangered under the California Endangered Species Act. The great gray owl occurs from Alaska to northern and south-central Ontario, Idaho, Montana, Wyoming, central Saskatchewan, northern Minnesota, and California (USDA 2006a). In California, they occur in the Sierra Nevada from the vicinity of Quincy and Plumas County, south to Yosemite National Park (CDFG 2008).

Hull et al. 2010 and Hull et al. 2014 found that great gray owls in the Yosemite area (i.e. including the Rim Fire area), are a genetically-unique population warranting subspecies status as *ssp. yosemitensis*. The genetic analysis completed by Hull et al. (2010) indicates that the *S.n. yosemitensis* population has experienced a recent genetic bottleneck and exhibits a small effective population size. Both of these factors are a significant conservation concern. The limited genetic diversity in this population may contribute to population instability because of the already low population levels, low census numbers, limited migration potential, and the potential for inbreeding depression (Ibid).

Great gray owls are regarded as locally rare throughout their range in USFS Region 5 and no more than 100-200 individuals have been estimated in California since 1980, and only 80 were estimated in 2006 (R5 Sensitive species Evaluation Form 2012). Although the great gray owl population in California is small, the Stanislaus contains more great gray owl sites than any other National Forest in Region 5, or any area outside of Yosemite National Park (Siegel 2001, 2002, NRIS Wildlife database, CNDDB database). Of the great gray owl sites on the Stanislaus, most are concentrated within the Rim Fire perimeter in areas that border Yosemite National Park.

Great gray owl sites are identified through the use of protocol surveys (Beck and Winter 2000, Keane et al. 2011). Protocol surveys for great gray owl have been conducted throughout the Rim Fire area for the past two decades. These surveys are best described as twofold: management oriented and research oriented. Management oriented survey work is generally opportunistic depending upon planned activities and funding levels. Research oriented survey work is generally more systematic and focused. Together these efforts have occurred at a level such that inventory information for the analysis area is considered essentially complete. Surveys have been conducted in the two breeding seasons post-fire (2014 to 2015) and we have documented great gray owls in four territories within the Rim Fire area.

The project action area is within the current distribution of great gray owls across the Sierra Nevada Bioregion. There are 13 territories documented within the action area. LOPs will be placed around all documented great gray owl PACs from March 1-August 15 of any given year during project implementation.

General habitat requirements for great gray owls include forested environments with high canopy cover and large trees that feature vegetation types such as Sierran Mixed Conifer, White fir, Red fir, Montane Hardwood, Montane Hardwood Conifer, Wet meadows, and Ponderosa Pine (CDFW 2008, Van Riper III and Van Wagtendok 2006). They typically nest in dense canopied forested stands adjacent to meadows or meadow complexes in large flat-topped broken snags. Availability of nesting structures and prey may limit the use of otherwise suitable habitat. Green (1995) found that occupied great gray owl sites had greater plant cover, vegetative height, and soil moisture. Canopy closure was the only variable of three variables measured (canopy closure, number of snags greater than 24 inches dbh, and number of snags less than 24 inches dbh) that was significantly higher in occupied sites versus unoccupied (Ibid). Home ranges have recently been estimated for Yosemite National Park. Breeding female home range size has been estimated at 152 acres while winter home ranges average 6,072 acres. Male breeding home ranges are estimated at 49 acres and winter home ranges average 5,221 acres (Van Riper III and Van Wagtendok 2006). Moderate to High Capability habitat is defined as that in which a CWHR suitability rating is ≥ 0.55. Two of three categories (reproduction, cover, food) must have a medium rating to achieve the minimum rating. Reference CWHR version 8.2 users' manual for further explanation on suitability ratings (CDFW 2008). Acres include NFS lands only. This includes Sierran mixed conifer, ponderosa pine, and white fir in CWHR type, size, and class (4M, 4D, 5M, 5D). About 40,000 acres of moderate to high capability year round habitat exist within the project action area on NFS lands only. This habitat is arranged in two general areas within the Rim fire perimeter; one area on the north end where Rim Fire burn severity was low to moderate and another area near the Highway 120 corridor. These two areas are disjunct, potentially prohibiting north to south movement or dispersal. Suitable breeding habitat is defined as suitable forested stands (4D, 5M, 5D) within 300 meters of an associated meadow or meadow complex. Survey data from occupied territories on the Stanislaus have documented great gray owls successfully nesting in stands classified by CWHR as 4D, thus this size and density class was included as highly suitable breeding habitat. About 2,387 acres is highly suitable breeding habitat on NFS lands and is unevenly distributed throughout the project area. About 73,700 acres of medium to highly suitable year round habitat exist within the cumulative effects analysis area.

Beck (1985), Bull and Duncan (1993), CDFG (2008) and Greene (1995) also describe suitable foraging habitat as follows:

- Open meadows and grasslands in forested areas
- Open woodlands and coniferous stands with herbaceous or shrub component
- Dense herbaceous cover, vegetative height and adequate soil moisture to provide suitable conditions for prey
- Trees, snags and fence posts present to serve as hunting perches

The diet of great gray owls may vary locally, but consists of small mammals, primarily rodents. Current literature indicates that great gray owls in the western United State overwhelmingly select two prey taxa: voles and pocket gophers (Bull and Duncan 1993). Voles prefer meadows with dense herbaceous vegetative cover (CDFW 2008). While it has been suggested by Beck (1985) that herbaceous heights ranging from 5 to 15 inches is suitable for voles, Greene (1995) found 12 inches to be preferred. Gophers are typically subterranean but also appear to have herbaceous cover preferences (Ibid). Compaction of meadow soils may reduce suitability of areas for gophers.

Not much is known on dispersal patterns in great gray owls. Bull et al (1988a) reported that maximum dispersal distance for juvenile owls to be 4.6 and 19.9 miles from their natal sites. They aren't considered migratory, though adults make short elevation movements during winter, presumably to areas with lower snow depths (Hayward and Verner 1994). In Oregon, adults exhibit nest site fidelity, 78% returning to within 0.6 miles of the previous year's nest site (Bull et al. 1988b).

Recent burns, where they exist in the Sierras, provide some structural similarity to a meadow ecosystem for a few years before the trees or brush shade out the grasses and forbs (Beck and Winter 2000). Such sites can provide foraging areas for nearby breeding great gray owls in the short-term (Greene 1995; Beck pers. comm.). Meadows or meadow complexes at least 25 acres in size appear to be necessary for persistent occupancy and reproduction but meadows as small as 10 acres will support infrequent breeding (Beck and Winter 2000). Reproductive sites are associated with high vole abundance and high vole abundance is associated with meadow vegetation height (Beck 1985; Greene 1995; Sears 2006; Kalinowski et al. 2014).

All great gray owl PACs burned at mixed severity in the Rim Fire. Overall, approximately half of all PAC acres burned at high severity (greater than 75% basal area mortality) and approximately 69% of known and potential nest sites were lost in the fire. There is potential for great gray owls to nest in burned forest (Beck, pers. comm.) and post-fire conditions may also provide preferred foraging habitat in the short-term (Greene 1995).

Mean home-range size in the Sierra Nevada during a radio-tagging study was estimated at 148 acres in females and 50 acres in males during the breeding season; great gray owls enlarge their home ranges substantially in winter (Van Riper and van Wagtendonk 2006). Most detections of great gray owls during the breeding season are within 300 meters of meadow habitat (Green 1995, Van Riper and Van Wagtendonk 2006, Winter 1986).

Risk Factors

USDA (2006a) summarized risk factors potentially influencing great gray owl abundance and distribution:

1. *Habitat loss and degradation*: Green tree and salvage timber harvest can eliminate potential nest trees.
2. *Range Management*: Grazing can remove cover necessary for prey species and degrade meadows, thereby lowering water tables and reducing productivity of grasses and forbs that are food sources for prey.
3. *Collision with automobiles*: Great gray owls are particularly susceptible to collisions with vehicles.
4. *Disease*: The effect of West Nile virus on owl populations is uncertain; however, given mortality rates in other avian species that have contracted this disease, a high mortality rate could be expected in infected great gray owls.
5. *Disturbance at nest and roost sites*: There is little information on disturbance and great gray owls; however, it is logical to assume they would respond like other owls. Spotted owls are known to have increased stress levels to disturbance such as chainsaw use and proximity to logging roads, which may affect reproduction (Hayward unpubl. data, USFWS 2006b, and Wasser et al. 1997).

Great Gray Owl: Environmental Consequences

The project alternatives could result in direct and indirect effects to the great gray owl through the following activities:

- Mechanical site preparation for planting.
- Herbicide application for site preparation and release of conifers.
- Planting and thinning conifers.

These direct and indirect effects include:

- Project related death, injury, or disturbance.
- Project related modifications to habitat quantity and/or quality.

Death, Injury and Disturbance

Death, injury and disturbance are potential direct effects to consider for great gray owl. Project activities have the potential to cause death or injury by tree-falling or by the use of heavy equipment. The great gray owl is also susceptible to getting “road killed”. Collision with vehicles is a major cause of mortality (Keane et al. 2011); great gray owls tend to fly low over the ground in open areas especially adjacent to meadows (Bull and Duncan 1993). LOPs mitigate the probability that death or injury would occur as a result of project activities. Loud noise from equipment such as chain saws or tractors is expected to occur in reforestation units and staging areas. Human presence in nest stands and loud noise in the vicinity of nest stands have the potential to change normal behavior and potentially impair essential behavior patterns of the great gray owl related to breeding, feeding or sheltering. The potential for disturbance under all action alternatives is minimized by the implementation of LOPs.

Habitat modification

Forested habitat is required by roosting and nesting great gray owls (Beck 1985; Greene 1995; Van Riper and Van Wagtendonk 2006; Winter 1981). Van Riper and Van Wagtendonk (2006) found that a significant proportion of breeding home ranges for females (73%) and males (75%) are comprised of forested habitat. Additionally, habitat loss has been identified as a risk influencing great gray owl abundance and distribution. Reestablishing forest habitat across the landscape and in close association with meadows is critical to ensure the viability of great gray owls in this landscape long-term.

Retention of snags and large downed woody debris is proposed under all action alternatives. Snags and down logs are important habitat elements for great gray owls and their prey (USDA 2001, Bull and Henjum 1990). Sears (2006) found that sites with a higher density of large snags were more likely to be occupied by great gray owl. Juveniles use leaning trees and snags for roosting before they can fly, and high stem density in stands are used by juveniles for cover and protection (Bull and Henjum 1990). Bull and Henjum (1990) noted that roosts accessible to flightless young, such as leaning and deformed trees and perches high enough to avoid terrestrial predators, may increase reproductive success. Retention of snags and large downed wood across the landscape will provide hunting, roosting and potentially nesting sites when associated with roosting or foraging habitat. These features are considered biological legacies in this post fire environment and will play important roles in the structure of future forest (Lindenmayer et al. 2008).

As great gray owls concentrate activities around meadows and have relatively small breeding home ranges, the potential for habitat modification effects are expected to be most pronounced in and near meadows as well as PACs.

Indicators

The following indicators were chosen to provide a relative measure of the direct and indirect effects to the great gray owl and to determine how well project alternatives comply with Forest Plan Direction. These criteria were chosen based on the best available scientific literature which focuses on various aspects of great gray owl ecology and life history requirements. These criteria focus on those life history aspects, or habitat elements, considered most limiting to great gray owl persistence across their range and where project effects are expected.

1. Acres of future moderate and high capability breeding habitat planted and thinned.
2. Toxicological effects from herbicide use.

Alternatives 1, 3 and 5

Because there is very little difference in the planting prescription under these three alternatives, the effects are expected to be similar and are analyzed together.

DIRECT AND INDIRECT EFFECTS

Indicator 1

Reforestation and Natural Regeneration

About 1,700 acres proposed for reforestation are within 300 meters of meadow habitat across the project area under Alternatives 1, 3 and 5. Planting conifers as prescribed under these alternatives would result in maximizing the reestablishment of forested habitat across this landscape when compared to Alternatives 2 and 4. These alternatives would provide the most habitat for great gray owls in close proximity to meadows in the long-term. Because habitat loss has been identified as a significant risk to great gray owl persistence across their range, reestablishing forest habitat across the landscape is paramount. Planting areas around meadow habitat as proposed under these alternatives would more quickly improve habitat conditions in the areas most important for breeding great gray owls.

Thinning

About 600 acres of existing plantation are within 300 meters of meadow habitat. These units are located throughout the project area and associated with several meadows, including Ackerson Meadow which is currently occupied by great gray owls. While some of these plantations are considered suitable because they are CWHR size class 4 or 5 and have greater than 40% canopy cover, they lack structural diversity. Thinning these plantations would promote vertical and horizontal diversity which in turn improves habitat capability. Prescribed fire would be the first tool used for thinning these stands. The goal is to open up these stands, creating a habitat mosaic with individual trees, clumps of trees and openings. The ICO design would provide structural diversity where it does not currently exist. For example, the prescription calls for releasing oaks and retaining diverse specie and sizes of residual trees. After thinning, remaining trees are expected to grow faster and understory vegetation would increase and diversify, improving habitat conditions for great gray owls and their prey in the short and long-term. In addition, by breaking up the continuity of vegetation, the habitat would be more resilient when fire or other stochastic events occur.

Indicator 2

Under Alternatives 1 and 5, herbicide use is expected to have a limited potential for direct or indirect toxicological effects on great gray owls, as described under the herbicide risk assessment section. Because no herbicides are proposed under Alternative 3, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to great gray owls would occur under this alternative.

Cumulative Effects

Appendix B identifies the present and reasonably foreseeable future actions on all lands within the analysis area. Some, but not all of these actions have or may contribute cumulatively to effects on great gray owls.

Based on risk factors affecting great gray owls, the following evaluation criteria were used as relative measures of cumulative effects for Alternatives 1, 3 and 5: breeding habitat suitability. In addition, Alternatives 1 and 5 used toxicological effects for evaluation criteria.

Breeding Habitat Suitability

Federal Lands

Present and foreseeable future activities on federal lands include: Funky Stewardship, Groovy Stewardship, Reynolds Creek Stewardship, Soldier Creek Timber Sale, Campy Timber Sale, Looney Timber Sale and Thommy Timber Sale which are green thinning projects treating 6,100 acres of forest across the analysis area. All snags and many declining trees will be retained unless they pose a safety hazard in these projects. The snag and declining tree retention will provide snags that could serve as potential nest sites for great gray owls in the short-term as well as recruits for future nest sites in the long-term. Fuels reduction associated with the Rim Recovery project would reduce the risk of further loss of remaining green forest within the project area. Other federal activities potentially affecting breeding habitat for great gray owls is livestock grazing, meadow restoration and the creation of great gray owl nest structures.

Thirteen grazing allotments are either wholly or partially within the analysis area, resulting in a maximum number of 1,632 cow/calf pairs across the project landscape. Livestock grazing may influence the abundance and availability of prey in wet meadows great gray owls use for foraging (Kalinowski et al. 2014).

Livestock grazing is subject to utilization and forest plan standards that are specifically designed to minimize grazing impacts on great gray owl prey. Meadow restoration projects (Reynolds Creek, Rim Fire Rehabilitation, Twomile Meadow Restoration) are expected to improve great gray owl foraging habitat across about 180 acres. The Rim Fire Rehabilitation project will also result in the creation of 30 to 50 nest structures adjacent to several meadows, replacing those lost in the fire as well as adding structures within the analysis area. Based on the biological evaluations for each of these projects, short-term impacts are minimal and great gray owl habitat is expected to improve in the long-term with implementation of these projects.

Toxicological Effects

Federal Lands

There is one present federal action of herbicide use on 0.5 acres under the Rim Fire Rehabilitation project and two foreseeable federal actions of herbicide use: 8.0 acres under the Twomile Ecological Restoration Noxious Weed project and 23 acres under a special use permit for the Reliable Power Project powerline. No other present or foreseeable future federal actions are related to herbicide use.

Private Lands

Herbicide use is proposed on 1,583 acres of private land within the project area in 2017. No other present or foreseeable future actions are proposed on private lands related to herbicide application.

Alternatives 1 and 5 Contribution and Summary

Alternatives 1 and 5 would contribute cumulatively to short and long-term beneficial effects on great gray owl by providing suitable breeding habitat across 1,700 acres more quickly than the other action alternatives. They would also contribute cumulatively to short and long-term beneficial effects on great gray owls by providing higher quality breeding habitat across 600 acres of existing plantation proposed for thinning. These alternatives would result in similar benefits with respect to existing plantation thinning when compared to Alternatives 3 and 4 because the thinning prescription is the same under all action alternatives. Alternatives 1, 3 and 5 would complement the new nest structures being constructed adjacent to several of the meadows considered. Alternatives 1 and 5 would contribute to the short-term limited potential of exposure to toxicity from herbicide use. The long-term benefits of herbicide use include the eradication of noxious weeds near Ackerson Meadow and Jawbone Lava Flat, which is expected to have beneficial effects on the habitat used by prey species important to great gray owls. The cumulative contribution under these alternatives may beneficially affect individual territories and the viability of this species.

Alternative 2

DIRECT AND INDIRECT EFFECTS

Under No Action, death, injury and disturbance would not be an issue because no active management would occur.

Indicator 1

The indirect effects of no action are primarily related to the influence no action may have on the amount and location of developing coniferous forest and how that may affect great gray owls. Because no active management would occur, it is unknown where naturally regenerating forest would occur, how long it would take to develop and what benefits it would provide great gray owls. Research and data collected from the project area show that areas in close proximity to live trees (i.e. seed source) experience limited forest expansion (Bonnet et al. 2005). Natural conifer expansion is sporadic, could be delayed for decades due to shrub suppression and would not likely result in significant gains in forested habitat (3.13 Vegetation). This could have greater implications for this population of great gray owls because they are already considered uncommon and rare on this landscape. If conifers are not planted to help reestablish breeding habitat in close proximity to meadows, the reduction in habitat availability could affect the number of great gray owls supported on the Stanislaus. Existing plantations would not be thinned under this alternative; therefore the benefits of increased structural diversity and improved habitat quality would not be realized. The plantations could be at greater risk of loss when fire returns to this landscape because of the tightly spaced live trees and fuel loading from fire killed trees (3.05 Fuels).

Indicator 2

Because no herbicides are proposed under this alternative, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to great gray owls would occur.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 outline those present and foreseeable future activities scheduled on public and private lands.

Alternative 2 Contribution and Summary

Under Alternative 2, no direct cumulative effect is expected because no active management would occur, however, there may be indirect consequences under this alternative primarily related to the influence no action may have on future forest development and how that may impact great gray owls. It is unknown if forest would naturally regenerate adjacent to meadows, which is a critical component of suitable breeding habitat. The cumulative contribution under this alternative may negatively affect individual territories and the number of great gray owls supported on the Stanislaus. It is unknown if this alternative would affect the viability of the species.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Indicator 1

Reforestation

Under Alternative 4, up to 23 acres is proposed for reforestation within 300 meters of meadow habitat. The effects associated with this alternative are considered the same as under the no action, see discussion under Alternative 2.

Thinning

Effects are the same as discussed under Alternatives 1, 3 and 5.

Indicator 2

Herbicide use is expected to have a limited potential for direct or indirect toxicological effects on great gray owls, as described under the herbicide risk assessment section above.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternative 1 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 4 Contribution and Summary

Under Alternative 4, a maximum of 23 acres is proposed for planting within 300 meters of meadow habitat. The cumulative contribution of Alternative 4 is primarily related to the influence this alternative may have on future forest development and how that may impact great gray owls. This alternative would not complement the existing plantation thinning nor would it completely complement the new nest structures being constructed adjacent to several of the meadows considered. This alternative would contribute cumulatively to short and long-term beneficial effects on great gray owls by providing suitable breeding habitat across 600 acres of existing plantation proposed for thinning. This alternative would result in similar benefits with respect to existing plantation thinning when compared to Alternatives 1, 3 and 5 because the thinning prescription is the same under all action alternatives. The long-term benefits of noxious weed treatments near Ackerson Meadow and Jawbone Lava Flat could be realized if prescribed fire and grazing are successful. Benefits include improved habitat condition in these areas used by prey species important to great gray owls. Alternative 4 would contribute to the short-term limited potential of exposure to toxicity from herbicide use. The cumulative contribution under this alternative may negatively affect individual territories and may affect the number of great gray owls supported on the Stanislaus. It is unknown if this alternative would affect the viability of the species.

Great Gray Owl: Summary of Effects

Indicator 1

Table 3.16-10 shows the number of acres proposed for reforestation (planting) and the number of acres of existing plantation proposed for thinning within 300 meters of meadow habitat. Alternatives 1, 3 and 5 would provide the most future breeding habitat for great gray owls when compared to Alternative 4. All action alternatives would result in the same amount of future breeding habitat within the treated existing plantations; however, Alternative 4 does not complement the existing plantation treatments by accelerating forest reestablishment in adjacent areas as proposed under Alternatives 1, 3 and 5.

Table 3.16-10 Great Gray Owl Summary of Effects: Future Moderate to High Capability Habitat

Metric	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Acres reforested[1]	1,700	0	1,700	0	1,700
Acres of existing plantation thinned	600	0	600	600	600
Total	**2,300**	**0**	**2,300**	**600**	**2,300**

[1] Includes natural regeneration

Indicator 2

Herbicide use under Alternatives 1, 4 and 5 are expected to have limited potential for direct or indirect toxicological effects on great gray owls. Because Alternative 4 has fewer acres of herbicide application proposed, the potential for effects would be less than under Alternatives 1 and 5. However, it is important to note that the toxicity exposure scenarios analyzed in the risk assessment show that all HQs are several orders of magnitude less than the NOAEL threshold of concern; therefore, great gray owls are provided an adequate margin of safety in the event that they are exposed to contaminated prey or water.

DETERMINATIONS

Alternatives 1 and 5

Alternatives 1 and 5 may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the great gray owl. This determination is based on the following rationale:

- These alternatives include actions to reestablish forested habitat adjacent to meadows, accelerating the time in which these areas would be suitable for breeding.
- These alternatives include actions to thin existing plantations, accelerating the time in which these areas would be suitable for breeding.
- These alternatives require the use of LOPs to reduce disturbance potential.
- These alternatives provide for surveys to establish or confirm the location of activity centers and boundaries.
- Toxicity exposure levels from herbicide use under these alternatives are all several orders of magnitude below the Forest Service established threshold of concern.

Alternative 2

Alternative 2 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the great gray owl. This determination is based on the following rationale:

- No actions would occur to potentially impact this species or its habitat. However, with no action to reestablish forested habitat, this alternative would result in less available breeding habitat in the short and long-term.

Alternative 3

Alternative 3 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the great gray owl. This determination is based on the following rationale:

- This alternative includes actions to reestablish forested habitat adjacent to meadows, accelerating the time in which these areas would be suitable for breeding.
- This alternative includes actions to thin existing plantations, accelerating the time in which these areas would be suitable for breeding.
- This alternative requires the use of LOPs to reduce disturbance potential.
- This alternative provides for surveys to establish or confirm the location of activity centers and boundaries.
- There would be no potential for exposure to herbicides.

Alternative 4

Alternative 4 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the great gray owl. This determination is based on the following rationale:

- This alternative includes actions to thin existing plantations, accelerating the time in which these areas would be suitable for breeding.
- This alternative requires the use of LOPs to reduce disturbance potential.
- This alternative provides for surveys to establish or confirm the location of activity centers and boundaries.
- Toxicity exposure levels from herbicide use under this alternative are all several orders of magnitude below the Forest Service established threshold of concern.

Northern Goshawk: Affected Environment

Species and Habitat Account

The northern goshawk (*Accipiter gentilis*) is a Region 5 Forest Service Sensitive species and is also listed with the State of California as a Species of Special Concern. Northern goshawks occur throughout North America and into Mexico. They occur throughout the Sierra Nevada year round and breed from about 2,400 feet to the crest as well as on the east side of the Sierra. On the west slope, they use a wide range of habitat types and are considered year round residents (USDA 2001).

Population trend of goshawks in California are poorly known. Distributional changes and loss of breeding territories from timber harvest and wildfire across their range suggest the population size has been reduced (Shuford and Gardali 2008). Ongoing concern that populations and reproduction may be declining in California due to changes in the amount and distribution of habitat has been documented (USDA 2001). Bloom and others (1986) estimated a statewide population of approximately 1,300 breeding territory records on public and private lands. Recent synthesis of existing breeding territory records documented approximately 1,000 known territories statewide between 1970 and 2001 (J. Keane and B. Woodbridge unpubl. data). As of 2014, there are 93 documented goshawk territories on the Stanislaus.

Northern goshawk sites are identified through the use of protocol surveys (USDA 2000a). Protocol surveys for goshawk have been conducted throughout the Rim Fire area for the past two decades. These surveys are best described as opportunistic depending upon planned activities and funding levels but have occurred at a level such that inventory information for the analysis area is considered essentially complete (USDA 2015). Surveys were conducted in 2014 and 2015, resulting in the addition of one new territory discovered in 2014.

The project area is within the current distribution of northern goshawks across the Sierra Nevada Bioregion. There are currently 21 territories within the action area. LOPs will be placed around all documented goshawk PACs from February 15-September 15 of any given year during project implementation.

General habitat requirements for northern goshawks include forested environments with high canopy cover (i.e. greater than 40%) that feature vegetation types such as Montane Hardwood, Montane Hardwood Conifer, Ponderosa and Jeffrey Pine, Sierran Mixed Conifer, Lodgepole Pine and Red Fir (CDFW 2008). Moderate to High Capability habitat is defined as that in which a CWHR suitability rating is greater than or equal to 0.55. Two of three categories (reproduction, cover, food) must have a medium rating to achieve the minimum rating. Reference CWHR version 8.2 users' manual for further explanation on suitability ratings (CDFW 2008). Acres include NFS lands only. There are about 42,800 acres of moderate and high capability habitat on NFS lands only. The remaining suitable habitat was fragmented by the Rim Fire. It is unknown to what extent this fragmentation has reduced the ability of goshawks to move between and utilize disjunct patches of habitat because they utilize a broad variety of habitats and have such large home ranges. There are about 75,800 acres of moderate and high capability habitat within the cumulative effects analysis area.

Goshawks typically nest in areas with a high density of large trees, high canopy cover, high basal area, and gentle to moderate slopes (Reynolds et al. 1992; USDA 2001). Breeding typically occurs in late winter to spring and is dependent on elevation and weather conditions. Nest sites are the focal point of goshawk breeding territories and are described by Keane (1999) and Maurer (2000):

- High canopy cover (average 65 to 70%).
- Greater number of large, live trees between 24 to 39 inches dbh (average 22 per acre).
- Greater number of large, live trees greater than 24 inches dbh (about 33 to 38 per acre).
- Open understory with low average shrub and sapling cover (about 9.9%).
- Low average numbers of small trees in the understory (less than 121 trees per acre and less than 226 trees per acre between 2 to 12 inches dbh).

Goshawks construct stick nests in live conifer, hardwood trees or snags. These nests are typically built in the lower portion of the canopy in a fork or crook of a tree, and occasionally next to the bole (3 to 10 feet) on a large branch (USDA 2001). Nest trees are reported to be among the largest trees in a stand (Ibid). Data from the Stanislaus show trees or snags ranging from 14 to 65 inches dbh have been selected as nest trees. Goshawks typically build more than one nest, placing alternates in adjacent trees or up to a half mile away (Reynolds et al. 1992). Annual variation in reproduction can be influenced by prey abundance, late winter and early spring temperature (Keane 1999).

Northern goshawks hunt on the wing, from elevated perches, and on the ground. They feed on a variety of birds and mammals such as Steller's jays, flickers, Douglas squirrels, and chipmunks (Ibid). The presence of structural elements such as snags and large downed woody debris provide important habitat for many prey species utilized by goshawks (Reynolds et al. 1992). Foraging habitat preferences of goshawks are poorly understood, although limited information from studies in conifer forests indicates they prefer to forage in mature forests with greater canopy closure and greater density of large trees greater than 40 inches dbh (Bright-Smith and Mannan 1994; Hargis et al. 1994). Reynolds et al. (1992) suggest that goshawks prefer relatively open shrub and lower canopy layers within forested stands, which may facilitate prey detection and capture.

Both natal and breeding dispersal are not well understood in northern goshawks due, in part, to the complexity of variables associated with dispersal, including the long distances that this species can disperse. Maximum natal dispersal distances in goshawks on the Kern Plateau were reported to range from 1.7 to 49 miles (Weins et al. 2006). One banded individual from this study was recovered 275 miles beyond the study area, indicating that dispersal distances are highly variable. Local recruits with short dispersal distances have been reported to establish breeding territories within three to five territories from their natal area (Ibid).

Nonbreeding period home ranges average about 20,300 acres for males and about 13,800 acres for females (USDA 2001). Breeding period home ranges average about 6,700 acres for males and about 5,000 acres for females (Ibid). Adult's exhibit site fidelity once breeding territories have been established (Reynolds and Joy 2006). Breeding dispersal does occur and has been reported at distances of about three to six miles for females and about two to four miles for males in Arizona and California (Reynolds and Joy 1998; Woodbridge and Detrich 1994). This species is not considered migratory, though limited altitudinal movements likely occur during winter months (USDA 2001).

Stand replacing fire events have eliminated nesting territories but goshawks are known to nest in stands that have experienced understory fires that did not reduce canopy cover and numbers of large trees below suitable levels (USDA 2001).

Risk Factors

Bloom et al. (1986), Keane and Morrison (1994), Kennedy (1997), Squires and Reynolds (1997), Smallwood (1998), and USDA (2001) summarize risk factors potentially influencing the abundance and distribution of northern goshawks:

1. *Loss of Breeding Habitat*: The major threat to goshawks are loss of breeding habitat from wildfire and the effects of vegetation management (timber harvest, fuels treatments, etc.).
2. *Breeding Site Disturbance*: Breeding site disturbance from vegetation treatments, human recreation and falconry harvest can negatively affect individuals and potentially local populations.
3. *Chemical pollutants*: Investigation of the potential risk of pollutants on this species, such as rodenticides and pesticides, is needed.
4. *Climate*: Weather and prey dynamics are primary factors affecting northern goshawk reproduction and potential survival. Climatic changes resulting in wetter winters and springs can affect northern goshawk demography.

Northern Goshawk: Environmental Consequences

The project alternatives could result in direct and indirect effects to the northern goshawk through the following activities:

- Mechanical site preparation for planting.
- Herbicide application for site preparation, release of conifers and noxious weed applications.
- Planting and thinning conifers.

These direct and indirect effects include:

- Project related death, injury and disturbance.
- Project related modifications to habitat quantity and/or quality.

Death, Injury and Disturbance

Death, injury and disturbance are potential direct effects to consider for northern goshawk (USDA 2004). Project activities have the potential to cause death or injury by tree-falling or by the use of heavy equipment. Death or injury could occur if nest trees are felled while being used by nesting birds during the reproductive season. The mobility of the species in question and the management requirement of LOPs make it highly improbable that death or injury would occur as a result of project activities.

Goshawks are highly susceptible to human disturbance (Squires and Reynolds 1997). During courtship and nest building, goshawks have been recorded to abandon nest areas following human intrusion alone (USDA 2000a). In addition, incubating or brooding females may interrupt incubation or nestling care for extended periods to defend a nest (Ibid).

Logging activities near nests can cause failure, especially during incubation (Boal and Mannan 1994). Using heavy equipment too close to active nests can cause abandonment, even with 20 day-old nestlings present (Squires and Reynolds 1997). Loud noise from equipment such as chain saws or tractors is expected to occur in reforestation and thinning units. Human presence, particularly loud noise, has the potential to change normal behavior and potentially impair essential behavior patterns of the northern goshawk related to breeding, feeding or sheltering. The potential for disturbance is minimized by LOPs.

The location of nest sites or activity centers are more uncertain following large-scale disturbance events (Keane, pers. comm.); conducting surveys to establish or confirm any new locations of nests or activity centers is a way to address this movement uncertainty (USDA 2000a). Conducting protocol surveys is a management requirement common to all action alternatives.

Habitat Modification

Woodbridge and Detrich (1994) found that northern goshawk territories associated with large contiguous forest patches were more consistently occupied compared to highly fragmented stands. Forested habitat is required by goshawks for roosting, nesting and foraging (Bright-Smith and Mannan 1994; Hargis et al. 1994; Reynolds et al. 1992; USDA 2001). Loss of breeding habitat from wildfire is known to be a risk factor affecting goshawk persistence in any given landscape. Reestablishing forested habitat in close proximity to remaining green forest, increasing habitat availability and reducing fragmentation across the project area would improve territory and landscape level habitat conditions for goshawks. Thinning existing plantations is also expected to accelerate growth rates and increase structural stand diversity, improving roosting, nesting and foraging habitat conditions sooner than without thinning. Thinning these areas would also increase resilience when fire returns to this landscape (3.05 Fuels). Reforestation and thinning would promote the viability of goshawks across this landscape long-term.

Retention of snags and large downed woody debris is proposed under all action alternatives. Short-term, within the next ten years, existing snags and down woody material will function as habitat elements important for goshawk prey. Snags also serve as potential hunting perch sites. Goshawks feed on a variety of prey present in post-fire habitat mosaics. Primary prey groups include tree and ground squirrels, cottontails, jackrabbits, hares and medium and large sized birds (Squires and Reynolds 1997). In the Sierra Nevada primary prey species are Douglas squirrel, golden- mantled ground squirrel, chipmunks, Steller's jay, northern flicker and American robin (Keane 1999).

Large snags and large down woody material are considered biological legacies in the post-fire environment and play important roles in the structure of the future forest (Lindenmayer et al. 2008). Snag dynamics in the Sierra Nevada are complex and snags fall at different rates depending on many factors (Cluck and Smith 2007). The time elapsed since fire is closely correlated with habitat elements present and the composition of prey species (Ingles 1965; Quinn and Keeley 2006). Ground squirrels, northern flickers and the American robin use a variety of open forest and shrub habitats with abundant insects and fruits (USDA 2001). Douglas squirrels use intermediate and mature stands containing large trees capable of providing cones and fungi, and Steller's jays prefer mature forest with open to moderate canopy cover and large, mature trees (Ibid). Thus, snags and down woody material serve different functional roles overtime for the goshawk, first providing cover for prey in the complex early seral stage of the forest, and ultimately decaying and playing a critical role in soil development of the future forest (Lindenmayer et al. 2008).

The management of goshawk habitat is typically thought of in three spatial scales (Reynolds et al. 1992; Reynolds et al. 2008). The first is the nesting habitat scale, or the PAC which corresponds to 200 acres. The second addresses the post-fledging area which corresponds to about 420 acres (USDA 2001), and the third addresses the whole foraging area or home range which corresponds to about 5,000 to 7,000 acres (Ibid).

Goshawks in the Sierra Nevada are year-round residents, and expand their breeding ranges in the winter (Keane 1999). As northern goshawks focus their breeding activities around roost and nest sites within PACs and raising young to fledgling status, habitat modification effects are expected to be most pronounced in PACs and post-fledging areas.

Indicators

The following indicators were chosen to provide a relative measure of the direct and indirect effects to the goshawk and to determine how well project alternatives comply with Forest Plan Direction. These criteria were chosen based on the best available scientific literature which focuses on various aspects of goshawk ecology and life history requirements. These criteria focus on those life history aspects, or habitat elements, considered most limiting to goshawk persistence across their range and where project effects are expected.

1. Acres of future moderate and high capability habitat planted or thinned.
2. Toxicological effects from herbicide use.

Alternatives 1, 3 and 5

Because there is little difference in the planting prescription and outcome in the short and long-term under these three alternatives, the effects are expected to be similar and are analyzed together. The difference in herbicides proposed between Alternatives 1 and 5 versus Alternative 3 were separated below accordingly.

DIRECT AND INDIRECT EFFECTS

Indicator 1

Reforestation and Natural Regeneration

Under Alternatives 1, 3 and 5, there are about 1,400 acres proposed for planting that fall within the estimated post fledgling areas of nine goshawk territories. Planting areas adjacent to and near goshawk territories as proposed under these alternatives would more quickly improve breeding habitat conditions for resident birds. Table 3.16-11 displays the affected territories and acres proposed for reforestation. Under these alternatives an additional 23,000 acres are proposed for reforestation across the project area that have the potential to benefit goshawks at the landscape scale. Planting conifers as prescribed under these alternatives would increase the amount of habitat available to goshawks by 57% on NFS lands in the long-term, maximizing the reestablishment of contiguous forested habitat across this landscape when compared to Alternatives 2 and 4. These alternatives would provide the greatest amount of habitat for goshawks in the long-term. Because habitat loss has been identified as a significant risk to goshawk persistence across their range, reestablishing forest habitat across the landscape is critical. At the landscape scale, reduced fragmentation and increased availability of suitable habitat is expected to benefit resident and dispersing goshawks.

Thinning

Under Alternatives 1, 3 and 5, about 85 acres of plantation thinning fall within the estimated post fledgling areas of five goshawk territories. Thinning existing plantation adjacent to and near occupied territories would also contribute to improving breeding habitat conditions for resident birds in the short and long-term. Table 3.16-11 displays the affected territories and acres proposed for thinning. Under these alternatives an additional 7,150 acres of existing plantation are proposed for thinning that have the potential to benefit goshawks at the landscape scale. While some of these plantations are considered suitable because they are CWHR size class 4 or 5 and have greater than 40% canopy cover, they lack structural diversity. Thinning these plantations would promote vertical and horizontal diversity which in turn improves habitat capability. Prescribed fire would be the first tool used for thinning these stands. Mechanical thinning prescriptions focus on using an ICO design that would provide structural diversity where it is currently lacking. For example, the prescription calls for releasing oaks and retaining diverse species and sizes of trees. After thinning, remaining trees are expected to grow faster and understory vegetation would become more abundant and diverse, improving habitat conditions for goshawks and their prey in the short and long-term. Also, by breaking up the continuity of vegetation across a given area, the habitat would be more resilient when fire or other stochastic events occur.

Table 3.16-11 Alternatives 1, 3 and 5: Proposed Treatment Acres within Goshawk Post-fledging Areas

Goshawk PAC ID	Reforestation[1]	Thin Existing Plantation	Total Treatment Acres within Post-fledging Area
Dimond O - D54T46	162	6	**168**
Bear Mtn - D54T01	222	14	**236**
Pilot Ridge - D54T08	106	0	**106**
Corral Creek - D54T10	246	0	**246**
Lower Cherry Creek - D54T13	1	41	**42**
Skunk Creek - D54T21	111	10	**121**
Niagra - D54T41	104	0	**104**
Soldier Creek - D54T43	116	0	**116**
SF Tuolumne River - D54T44	34	13	**47**

[1] Includes natural regeneration

Indicator 2

Under Alternatives 1 and 5, herbicide use is expected to have a limited potential for direct or indirect toxicological effects on goshawks, as described under the herbicide risk assessment section. Because no herbicides are proposed under Alternative 3, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to goshawks would occur.

CUMULATIVE EFFECTS

Appendix B identifies the present and reasonably foreseeable future actions on all lands within the analysis area. Some, but not all of these actions have or may contribute cumulatively to effects on goshawks.

Based on risk factors affecting goshawks, the following evaluation criteria were used as relative measures of cumulative effects from Alternatives 1, 3 and 5: habitat modification. In addition, Alternatives 1 and 5 used toxicological effects for evaluation criteria.

Habitat Modification

Federal Lands

Present and foreseeable future activities on federal lands include: Funky Stewardship, Groovy Stewardship, Reynolds Creek Stewardship, Soldier Creek Timber Sale, Campy Timber Sale, Looney Timber Sale, Thommy Timber Sale, which are green thinning projects treating 6,100 acres of forest across the analysis area. All snags and many declining trees will be retained unless they pose a safety hazard in these projects. The snag and declining tree retention will provide snags that could serve as potential roost or nest sites for goshawks in the short-term as well as recruits for future nest sites in the long-term. Other federal activities potentially impacting breeding habitat for goshawks is fuels reduction associated with the Rim Recovery project. Fuels reduction associated with this project would reduce the risk of further loss of remaining green forest within the project area.

Toxicological Effects

Federal Lands

There is one present federal action of herbicide use on 0.5 acres under the Rim Fire Rehabilitation project and two foreseeable federal actions of herbicide use: 8.0 acres under the Twomile Ecological

Restoration Noxious Weed project and 23 acres under a special use permit for the Reliable Power Project powerline. No other present or foreseeable future federal actions are related to herbicide use.

Private Lands

Herbicide use is proposed on 1,583 acres of private land within the project area in 2017. No other present or foreseeable future actions are proposed on private lands related to herbicide application.

Alternatives 1, 3 and 5 Contribution and Summary

Alternatives 1, 3 and 5 would contribute cumulatively to short and long-term effects to northern goshawks. Under these alternatives, reforestation on about 24,400 acres would increase the amount of moderate and high capability habitat available across the analysis area by 32% in the long-term. Under these alternatives about 7,240 acres of existing plantation would be thinned, promoting structural diversity and improving habitat capability in the short and long-term. These alternatives would result in similar benefits with respect to existing plantation thinning when compared to Alternative 4 because the thinning prescription is the same under all action alternatives. Alternatives 1 and 5 would contribute to the short-term limited potential of exposure to toxicity from herbicide use. Alternatives 1, 3 and 5 would result in the greatest increase in available habitat and connectivity at the landscape scale when compared to Alternatives 2 and 4. The cumulative contribution under this alternative is expected to benefit resident and dispersing goshawks and is not expected to affect the viability of this species.

Alternative 2

DIRECT AND INDIRECT EFFECTS

Indicator 1

The indirect effects of no action are primarily related to the influence no action may have on the amount of moderate and high capability habitat available, the restoration of habitat connectivity across the landscape, and how that may impact northern goshawks in the long-term. Under this alternative, about 9,800 acres of forested habitat is predicted to develop naturally across the landscape. This would increase habitat availability across NFS lands by 23%, almost two thirds less than that expected under Alternatives 1, 3 and 5. Because no active management would be used, it is unknown where naturally regenerating forest would occur and what benefits that would provide goshawks. It is likely that areas in close proximity to live trees (i.e. seed source) would experience forest expansion to a limited degree, depending on the competing vegetation in the localized area. It should be noted that natural conifer expansion is sporadic in nature, could be delayed for decades due to shrub suppression, would likely be dominated by fir and would not result in significant gains in forested habitat (3.13 Vegetation). Areas far from seed sources would likely persist as chaparral for decades if not well over a hundred years. Existing plantations would not be thinned under this alternative; thereby, not increasing structural diversity or improving habitat quality. The plantations could be at greater risk of loss when fire returns to this landscape because of the tightly spaced live trees and fuel loading from fire mortality than if treated as proposed under the action alternatives (3.05 Fuels).

Indicator 2

Because no herbicides are proposed under Alternative 2, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to goshawks would occur.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 2 Contribution and Summary

Under Alternative 2, no direct cumulative effect is expected because no active management would occur, however, there may be indirect consequences under this alternative primarily related to the influence no action may have on future forest development and how that may impact northern goshawks. At the landscape scale, the cumulative contribution under this alternative would increase the available suitable habitat by 13% (9,800 acres) compared to a 32% increase (acres) under Alternatives 1, 3 and 5. It is unknown where it would occur and how long it would take natural regeneration to establish and what, if any, benefits that would provide to goshawks at the territory or landscape level. The cumulative contribution under this alternative may negatively affect individual or resident birds, but is not expected to affect the viability of this species.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Indicator 1

Reforestation

Under Alternative 4, about 208 acres proposed for planting fall within the estimated post fledgling areas of nine goshawk territories. This is 1,200 acres less than Alternatives 1, 3 and 5. Table 3.16-12 displays these territories and acres proposed for reforestation. Under this alternative, up to 2,742 additional acres are proposed for reforestation within the project area. The planting prescription under this alternative is termed founder stands. This prescription calls for small variable shaped planting areas ranging from two to ten acres in size within a larger unplanted area. The unplanted area would likely be comprised of chaparral with scattered oaks. The planted area is only 20% of a given unit. Herbicides would be used to control shrubs and competing vegetation within planted areas and incorporating a 50 foot buffer around planted areas. These trees would be planted with a much tighter spacing, groups of 5 trees spaced 6 feet from each other. With the tighter spacing it may be necessary to thin the plantations around year 7 to allow growing space for the trees to mature.

Table 3.16-12 Alternative 4: Proposed Treatment Acres within Goshawk Post-fledging Areas

Goshawk PAC ID	Reforestation[1]	Thin Existing Plantation	Total Treatment Acres within Post-fledging Area
Dimond O - D54T46	26	6	**31**
Bear Mtn - D54T01	46	14	**59**
Pilot Ridge - D54T08	15	0	**15**
Corral Creek - D54T10	47	0	**47**
Lower Cherry Creek - D54T13	8	41	**49**
Skunk Creek - D54T21	22	10	**32**
Niagra - D54T41	19	0	**19**
Soldier Creek - D54T43	22	0	**22**
SF Tuolumne River - D54T44	3	13	**16**

[1] Includes natural regeneration

Prescribed fire would be applied to 50% of the areas adjacent to the planted areas within ten years and the other 50% within 20 years. Reforesting in this manner would result in several small fragmented patches of forested habitat no bigger than ten acres separated by large tracts of chaparral. Small patches of forested habitat covering 20% of a given area would not provide the moderate and high capability habitat required by breeding goshawks, which include large tract of contiguous forest. Similar to the No Action Alternative, about 9,800 acres of forested habitat is predicted to develop naturally with no active management across the landscape. Because no active management would occur on these acres, it is unknown where naturally regenerating forest would occur and what benefits it would provide for goshawks. It is likely that areas in close proximity to live trees (i.e. seed source) would experience forest expansion to a limited degree, depending on the competing vegetation in the localized area. It should be noted that natural regeneration is sporadic in nature, could be delayed for decades due to shrub suppression, would likely be dominated by fir and would not result in significant gains in forested habitat (3.13 Vegetation). Areas far from seed sources would likely persist as chaparral for decades if not well over a hundred years. Under this alternative forested habitat could increase up to 30% on NFS lands, but it is unknown how fragmented or contiguous the distribution would be across the landscape and if it would provide benefits to goshawks at the territory or landscape scale.

Thinning

About 7,235 acres of existing plantation proposed for thinning have the potential to benefit goshawks at the PAC, post-fledging and landscape scale. Effects expected from plantation thinning are the same as those discussed under Alternatives 1, 3 and 5.

Indicator 2

Herbicide use is expected to have limited potential for direct or indirect toxicological effects on goshawks, as described under the herbicide risk assessment section.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 4 Contribution and Summary

Alternative 4 would contribute cumulatively to short and long-term effects to northern goshawks. Under this alternative, reforestation on up to 2,950 acres in discreet patches no larger than ten acres is not expected to result in benefits to goshawk. Reforestation and natural forest recovery is expected to increase available habitat by up to 17% across the analysis area. However, this natural forest recovery is expected to be sporadic, delayed and a limited contribution to moderate and high capability habitat in the long-term. The founder stands prescription is not expected to provide moderate and high capability habitat because it would be located in small fragmented patches separated by large tracts of chaparral. Under this alternative about 7,235 acres of existing plantation would be thinned, promoting structural diversity and improving habitat capability in the short and long-term. This alternative would result in similar benefits with respect to existing plantation thinning when compared to Alternatives 1, 3 and 5 because the thinning prescription is the same under all action alternatives. Alternative 4 would contribute to the short-term limited potential of exposure to toxicity from herbicide use. The cumulative contribution under this alternative is expected to provide limited benefits to resident and dispersing goshawks and is not expected to affect the viability of this species.

Northern Goshawk: Summary of Effects

Indicator 1

Table 3.16-13 shows the number of proposed planting acres and the number of existing plantation acres proposed for thinning at the post-fledging and landscape scales. Alternatives 1, 3 and 5 would provide the greatest amount of moderate and high capability habitat for goshawks in the long-term when compared to Alternative 4. All action alternatives would result in the same amount of future moderate and high capability habitat within the treated existing plantations; however, Alternative 4 does not complement the existing plantation treatments by accelerating forest reestablishment in adjacent areas or across the landscape as proposed under Alternatives 1, 3 and 5.

Indicator 2

Herbicide use under Alternatives 1, 4 and 5 are expected to have limited potential for direct or indirect toxicological effects on goshawks. Because Alternative 4 has fewer acres of proposed herbicide application, the potential for effects would be less than under Alternatives 1 and 5. However, it is important to note that the toxicity exposure scenarios analyzed in the risk assessment show that all HQs are several orders of magnitude less than the NOAEL threshold of concern; therefore, goshawks are provided an adequate margin of safety in the event that they are exposed to contaminated prey or water.

Table 3.16-13 Northern Goshawk Summary of Effects: Future Moderate to High Capability Habitat

Metric	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Acres reforested in post-fledging area[1]	1,400	0	1,400	208	1,400
Acres reforested[1] (landscape)	23,000		23,000	2,742	23,000
Total reforested acres	**24,400**	**0**	**24,400**	**2,950**	**24,400**
Acres of existing plantation thinned in post fledgling area	85	0	85	85	85
Acres of existing plantation thinned (landscape)	7,235		7,235	7,235	7,235
Total thinned acres	**7,320**	**0**	**7,320**	**7,320**	**7,320**

[1] Includes natural regeneration

Determinations

ALTERNATIVES 1 AND 5

Alternatives 1 and 5 may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the Northern goshawk. This determination is based on the following rationale:

- These alternatives include actions to reestablish contiguous forested habitat, accelerating the time in which these areas would be suitable for nesting, roosting and foraging.
- These alternatives include actions to thin existing plantations, accelerating the time in which these areas would be suitable for nesting, roosting and foraging.
- Habitat connectivity would be restored under these alternatives.
- Snag retention in close proximity to green forest would result in maintaining roosting and nesting structures as well as habitat for prey throughout the treated areas.
- These alternatives require the use of LOPs to reduce disturbance potential to breeding goshawks.
- These alternatives provide for surveys to establish or confirm the location of activity centers and boundaries.
- Toxicity exposure levels from herbicide use under these alternatives are all several orders of magnitude below the Forest Service established threshold of concern.

ALTERNATIVE 2

Alternative 2 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the Northern goshawk. This determination is based on the following rationale:

- This alternative would result in the smallest increase in moderate to high capability habitat available to goshawk in the long-term.
- The structural diversity of existing plantations would not be promoted and thus habitat quality would not be improved in the short or long-term.
- Existing plantations may be at greater risk of loss when fire returns to this landscape.
- There would be no potential for exposure to herbicides.

ALTERNATIVE 3

Alternative 3 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the Northern goshawk. This determination is based on the following rationale:

- This alternative includes actions to reestablish contiguous forested habitat, accelerating the time in which these areas would be suitable for nesting, roosting and foraging.
- This alternative includes actions to thin existing plantations, accelerating the time in which these areas would be suitable for nesting, roosting, and foraging.
- Habitat connectivity would be restored under this alternative.
- Snag retention in close proximity to green forest would result in maintaining roosting and nesting structures as well as habitat for prey throughout the treated areas.
- This alternative requires the use of LOPs to reduce disturbance potential to breeding goshawks.
- This alternative provides for surveys to establish or confirm the location of activity centers and boundaries.
- There would be no potential for exposure to herbicides.

ALTERNATIVE 4

Alternative 4 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the Northern goshawk. This determination is based on the following rationale:

- This alternative includes actions to establish small fragmented patches of forest that would not provide suitable nesting or roosting habitat.
- This alternative includes actions to thin existing plantations, accelerating the time in which these areas would be suitable for nesting, roosting and foraging.
- Snag retention in close proximity to green forest would result in maintaining roosting and nesting structures as well as habitat for prey throughout the treated areas.
- This alternative requires the use of LOPs to reduce disturbance potential to breeding goshawks.
- This alternative provides for surveys to establish or confirm the location of activity centers and boundaries.
- Toxicity exposure levels from herbicide use under this alternative are all several orders of magnitude below the Forest Service established threshold of concern.

Pacific Marten: Affected Environment

Species and Habitat Account

The marten (*Martes caurina*) is a Region 5 Forest Service Sensitive species and is also a Sierra Nevada Management Indicator Species (MIS), as described in the MIS Report. Marten occur throughout much of their historic range from Trinity and Siskyou counties east to Mount Shasta, south through the Cascades and Sierra Nevada ranges to Tulare County. They are considered rare when compared to other forest carnivore species (USDA 2001). Their core elevation range is 5,500 to 10,000 feet. Marten have been documented on the Stanislaus as low as 3,200 feet elevation.

Population estimates and trends are not available for marten in California. Although classified as a furbearer, there has been no open trapping season for this species since 1954 (USDA 2001). Declines in marten population size in the early twentieth century have been attributed to habitat modifications, trapping, and predator control. Based on surveys conducted from 1989-2002, the marten appears to occupy much of its historic range in California (Zielinski et al. 1995; Slauson et al. 2007).

Carnivore camera stations have been employed within suitable habitat in and near the project area from 2005 to 2015. No marten detections were made as a result of these survey efforts (NRIS Wildlife database).

The project is within the current distribution of marten across the Sierra Nevada Bioregion. The nearest documented occurrence of marten was in 2006 less than two miles north of the project area near Reynolds Creek and south of the project area in Yosemite National Park. Their presence within the analysis area is unknown; however, presence is assumed where suitable habitat exists. Because no documented den sites exist, LOPs for this species are not required for this project.

Marten are considered one of the most habitat-specific mammals in North America. Habitat quality is likened to the structural diversity consistent with late seral, mesic coniferous forests, interspersed with riparian areas and meadows. Preferred forest vegetation types include red fir, red fir/white fir mix, lodgepole pine, and Sierra mixed conifer (Freel 1991). Marten home ranges are very large relative to their body size. Mean home ranges in the central Sierra Nevada are 960 acres for males and 801 acres for females (USDA 2001). The analysis area still contains relatively high quality habitat for marten in areas that burned at low or low-moderate intensity such as Twomile, Bourland, and Reynolds Creek, Pilot Ridge and the Crocker Meadow area. Moderate to high capability habitat is defined as that in which a CWHR suitability rating is greater than or equal to 0.55. Two of three categories (reproduction, cover, food) must have a medium rating to qualify as moderate or high capability habitat. Suitable habitat consists of CWHR habitat types Jeffrey pine, lodgepole pine, montane hardwood conifer, ponderosa pine, red fir, sierra mixed conifer, and white fir and size classes 4P, M, D, 5M, D. The analysis area contains about 17,692 acres of moderate and high capability habitat on NFS lands only. About 45,300 acres of moderate and high capability habitat are within the cumulative effects analysis area, including all ownerships.

A road density of less than 1 mile of road per square mile has been recommended for high quality habitat for marten and a road density of 1 to 2 miles per square mile is recommended for medium capability habitat (USDA 1991). The road density including all routes open to motor vehicles in the analysis area is 3.0 miles per square mile on NFS lands and is more than twice the acceptable density found in high quality habitat and more than 1 mile per square mile above that found in moderate capability habitat.

Marten natal dens are typically found in cavities in large trees, snags, stumps, logs, shrubs, burrows, caves, rocks, or crevices in rocky areas (USDA 1991 and Zielinski et al. 1997). Dens are lined with vegetation and are found in structurally complex, late succession forests (Buskirk and Powell 1994). Breeding occurs from late June to early August, followed by embryonic diapause, and birth in March-April (Ibid).

Freel (1991), Slauson (2003), and Spencer et al. (1983) characterized suitable habitat for denning/resting marten as follows:

- Canopy cover greater than or equal to 70%.
- Largest live conifers are greater than or equal to 24 inches dbh and occur at a density of at least 9 per acre.
- Live tree basal area ranges from 163 to 326 square feet per acre.
- Snags average 25 square feet basal area per acre and average 30 inches dbh.
- Coarse woody debris is present at 5 to 10 tons per acre in decay classes 1 and 2.

Marten diet varies geographically and seasonally with local prey availability. In the Central Sierra, marten diets are comprised primarily of voles, while in the southern Sierra it is squirrels and voles, insects, hypogeous fungi and secondarily (less than 20% of diet) reptiles and birds (Zielinski et al. 1983; Zielinski and Duncan 2004). Zielinski and others (1983) noted Douglas squirrels, snowshoe hare, northern flying squirrels and deer mice were the prey species used almost exclusively during the winter, while ground squirrels formed the largest component of the diet from late spring through fall.

Coarse woody debris is an important component of marten habitat, especially in winter, when it provides structure that intercepts snowfall and creates subnivean (below snow) tunnels, interstitial spaces, and access holes. Zielinski and others (1983) suggested that marten activity varied to take advantage of subnivean dens utilized by their prey. Sherburne and Bissonette (1994) found that when coarse woody debris covered a greater percent of the ground, marten use also increased. Older growth forests appeared to provide accumulated coarse woody debris necessary to enable marten to forage effectively during the winter.

Freel (1991) and Spencer et al. (1983) characterized suitable habitat for travel/foraging marten as follows:

- Canopy cover greater than or equal to 40%.
- Largest live conifers are greater than or equal to 24 inches dbh and occur at a density of at least 6 per acre.
- Largest snags average 2.5 per acre and are greater than or equal to 24 inches dbh (8 sqarefeet per acre).
- Coarse woody debris is present at 5 to 10 tons per acre in decay classes 1 through 3.

Reports of long-distance movements, likely representing dispersal, are largely anecdotal. Movement patterns in marten, dispersal and migration, have not been intensively studied for this species because of the difficulty and high cost of studying long-distance movements in small bodied mammals (Buskirk and Powell 1994; Ruggiero et al. 1994). Martens exhibit seasonal variation in habitat selection within stable home ranges, with little evidence to suggest shifts in home range boundaries.

RISK FACTORS

Hargis et al. (1999) and USDA (2001) summarize several risk factors potentially influencing marten abundance and distribution:

1. *Habitat fragmentation*: Fragmentation can limit occupancy and dispersal of marten across the landscape. Marten were negatively associated with low levels of habitat fragmentation. When the average nearest neighbor distance between non-forested patches was less than 100 meters, it created more edge and less interior forested habitat preferred by marten.
2. *Meadow habitat degradation*: Grazing can reduce the amount of shrub and herbaceous cover available and can increase soil compaction for prey species such as voles.
3. *Fire suppression*: Fire suppression has contributed to degraded conditions in meadows and riparian habitats by allowing encroachment of trees which reduces the availability of understory vegetation required by prey.
4. *Lack of, or removal of coarse woody debris*: Removal of coarse woody debris (piles of several smaller logs, or single large logs) can also reduce access and abundance of prey during the important winter months, and may also reduce resting site availability for marten.

Pacific Marten: Environment Consequences

The project alternatives could result in direct and indirect effects to the marten through the following activities:

- Mechanical site preparation.
- Herbicide application for site preparation, release, and noxious weed applications.
- Planting conifers.

These direct and indirect effects include:

- Project related death, injury and disturbance.
- Project related modifications to habitat quantity or quality.

Death, Injury and Disturbance

Death or injury from project related activities would be unlikely to occur given the mobility of this species. However, if a den or rest tree were felled while being used by martens death or injury could occur.

Project activities, especially loud noise, could result in disturbance that may impair essential behavior patterns of the marten related to denning, resting or foraging. Loud noise from equipment such as chain saws, tractors or feller bunchers is expected to occur in all treatment units. The location of marten within the analysis area is uncertain following the 2013 Rim Fire, a large-scale disturbance event. Temporary avoidance of the project site or displacement of individuals is expected during project implementation. Any displacement or avoidance would be of short duration and would subside shortly after project completion. LOPs in place for spotted owls and goshawks would afford protection to individual marten in these areas during parturition, kit rearing and subsequent breeding (March through August). The potential risk to individual marten is considered low because of the lack of documented marten occurrence within or near the analysis area.

Habitat Modification

Reforesting areas that burned at high severity would accelerate development of forest habitat, increasing the amount of habitat available and restoring connectivity across the landscape. Active or managed reforestation is predicted to provide more complex habitat conditions in the long-term. For example, active reforestation would result in more large trees (e.g., greater than or equal to 24 inches dbh) and higher levels of snag recruitment when compared to the No Action Alternative. Thinning existing plantations is also expected to accelerate growth rates and increase structural stand diversity, improving foraging and breeding habitat conditions sooner than without thinning. Thinning these areas would also increase resilience when managed or wildfire returns to this landscape. Reducing fragmentation and increasing the amount of interior forest is likely to increase habitat effectiveness and use by marten (Hargis et al. 1999).

Retention of snags and large downed woody debris is proposed under all action alternatives. Retention of snags and downed logs within reforestation and thinning units and in close proximity to currently suitable habitat (green forest) would provide denning and resting sites, as well as habitat for prey species (Freel 1991). The number of snags and downed logs available across a marten's home range affects the quality of that habitat for foraging and breeding. For example, they select sites with at least 25 square feet of basal area per acre of large snags (Slauson 2003; Spencer et al. 1983). While Spencer does not report an average dbh of snags, Slauson (2003) reports snags average 30 inches dbh in areas where marten were detected. In moderate and high capability traveling and foraging habitat they use areas with fewer snags, eight to twelve square of feet basal area per acre that are 24 inches dbh or greater (Freel 1991).

Long-term, large snags and large downed logs are considered biological legacies in a post fire environment and play important roles in the structure of future forest (Lindenmayer et al. 2008). Large snags and downed logs may take hundreds of years to develop, emphasizing the need to retain these elements across the landscape. Because large snags and large downed logs are important habitat elements found in high capability marten habitat, it is important to retain these structural elements during project implementation to provide structural diversity within thinned or newly planted areas.

Indicators

The following indicators were chosen to provide a relative measure of the direct and indirect effects to the marten and to determine how well project alternatives comply with Forest Plan Direction. These criteria were chosen based on the best available scientific literature which focuses on various aspects of marten ecology and life history requirements. These criteria focus on those life history aspects, or habitat elements, considered most limiting to marten persistence across their range and where project effects are expected.

1. Acres of future moderate and high capability habitat planted and thinned.
2. Toxicological effects from herbicide use.

Alternatives 1, 3 and 5

Because these three Alternatives propose reforestation and thinning within the same locations, the effects are expected to be similar and are analyzed together. The differences in herbicides proposed between Alternatives 1 and 5 versus Alternative 3 were separated below accordingly.

DIRECT AND INDIRECT EFFECTS

Indicator 1

Reforestation and Natural Regeneration

Under these alternatives, about 3,400 acres are proposed for reforestation within the elevation range typically used by marten. Planting conifers as prescribed under these alternatives would result in the restoration of moderate and high capability forested habitat across the landscape. This would increase the amount of habitat available to marten by 19% on NFS lands in the long-term. While habitat connectivity is still largely intact at the landscape scale within this elevation range, the proposed reforestation would restore habitat connectivity to adjacent private lands that are also being reforested.

Thinning

About 4,900 acres of existing plantation are proposed for thinning within the elevation range used by marten. While some of these plantations are considered suitable because they are CWHR size class 4 or 5 and have greater than 40% canopy cover, they lack structural diversity. Thinning these plantations would promote vertical and horizontal diversity which in turn improves habitat capability. Prescribed fire would be the first tool used for thinning these stands. Mechanical thinning prescriptions for these plantations focus on using an ICO design that would provide structural diversity where it does not currently exist. For example, the prescription calls for releasing oaks and creating groups of trees separated by openings. After thinning, remaining trees are expected to grow faster and understory vegetation would become established, improving habitat conditions for marten and their prey in the short and long-term. By breaking up the continuity of vegetation across a given area, the habitat would be more resilient when fire or other stochastic events occur.

These alternatives address and maximize habitat suitability and connectivity in the short and long-term for marten on this landscape. Because marten have not been documented in the project area, it is unknown if marten would realize the benefits discussed in this analysis.

Indicator 2

Under Alternatives 1 and 5, herbicide use is expected to have an extremely limited potential for direct or indirect toxicological effects on marten, as described under the herbicide risk assessment section. Because no herbicides are proposed under Alternative 3, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to marten would occur under this alternative.

CUMULATIVE EFFECTS

Appendix B identifies the present and reasonably foreseeable future actions on all lands within the analysis area. Some, but not all of these actions have or may contribute cumulatively to effects on marten.

Based on risk factors affecting marten, the following evaluation criteria were used as relative measures of cumulative effects from Alternatives 1, 3 and 5: habitat modification. In addition, Alternatives 1 and 5 used toxicological effects for evaluation criteria.

Habitat Modification

Federal Lands

Present and foreseeable future activities on federal lands include: Funky Stewardship, Groovy Stewardship, Reynolds Creek Stewardship, Soldier Creek Timber Sale, Campy Timber Sale, Looney Timber Sale, Thommy Timber Sale, which are green thinning projects treating 6,100 acres of forest across the analysis area. All snags and many declining trees will be retained unless they pose a safety hazard in these projects. Downed woody debris will be retained at rates up to 20 tons per acre. The snag, declining tree and downed log retention in these projects will provide snags and downed logs that could serve as potential denning or resting sites for marten in the short-term as well as recruits for future den and rest sites in the long-term. Fuels reduction associated with the Rim Recovery project will reduce the risk of further loss of remaining green forest within the project area. One other federal activity potentially impacting habitat for marten is meadow restoration.

Meadow restoration projects (Reynolds Creek, Rim Rehabilitation, Twomile Meadow Restoration) are expected to improve foraging habitat across about 290 acres. Treatments would result in improved functioning of meadow habitat, thus improve conditions for prey species that utilize these areas.

Toxicological Effects

Federal Lands

There is one present federal action of herbicide use on 0.5 acres under the Rim Fire Rehabilitation project and two foreseeable federal actions of herbicide use: 8.0 acres under the Twomile Ecological Restoration Noxious Weed project and 23 acres under a special use permit for the Reliable Power Project powerline. No other present or foreseeable future federal actions are related to herbicide use.

Private Lands

Herbicide use is proposed on 1,583 acres of private land within the project area in 2017. No other present or foreseeable future actions are proposed on private lands related to herbicide application.

Alternatives 1, 3 and 5 Contribution and Summary

Alternatives 1, 3 and 5 would contribute cumulatively to short and long-term effects to marten. Under these alternatives, reforestation on about 3,400 acres would provide the most suitable foraging, denning and resting habitat when compared to Alternative 4. Reforestation under these alternatives would result in an 8% increase in moderate and high capability habitat available across the analysis area in the long-term. Under these alternatives about 4,900 acres of existing plantation would be thinned, promoting structural diversity and improving habitat capability in the short and long-term. These alternatives would result in similar benefits with respect to existing plantation thinning when compared to Alternative 4 because the thinning prescription is the same under all action alternatives. Alternatives 1 and 5 would contribute to the short-term limited potential of exposure to toxicity from herbicide use. Because no documented occurrences of marten exist in the project area, it is unknown to what degree the cumulative contribution under this alternative may affect individuals. The cumulative effects considered in this analysis are not expected to affect the viability of this species.

Alternative 2

DIRECT AND INDIRECT EFFECTS

Indicator 1

The indirect effects of no action are primarily related to the influence no action may have on the amount of suitable forested habitat available to marten in the long-term. Under this alternative, only about 940 acres of forested habitat is predicted to develop naturally with no active management within the elevation range of marten. Because no active management would occur, it is unknown where naturally regenerating forest would occur and what benefits that would provide marten. It is likely that areas in close proximity to live trees (i.e. seed source) would experience forest expansion to a limited degree, depending on the competing vegetation in the localized area. It should be noted that natural conifer expansion is sporadic in nature, could be delayed for decades due to shrub suppression, would likely be dominated by fir and would not result in significant gains in forested habitat (3.13 Vegetation). Areas far from seed sources would likely persist as chaparral for decades if not more than a hundred years. Existing plantations would not be thinned under this alternative; therefore, increasing structural diversity and improving habitat quality would not be realized. The plantations could be at greater risk of loss when fire returns to this landscape because of the tightly spaced live trees and fuel loading from fire mortality than if treated as proposed under the action alternatives. Habitat connectivity is still relatively intact where marten are expected to occur. This alternative would result in a very small increase in long-term habitat available to marten on NFS lands.

Indicator 2

Because no herbicides are proposed under Alternative 2, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to marten would occur under this alternative.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 2 Contribution and Summary

Under Alternative 2, no direct cumulative effect is expected because no active management would occur, however, there may be indirect consequences under this alternative primarily related to the influence no action may have on future forest development and how that may impact marten. At the landscape scale, the cumulative contribution under this alternative would only increase the available suitable habitat by 2% (940 acres) compared to 8% (3,400 acres) under Alternatives 1, 3 and 5. Because no documented occurrences of marten exist in the project area, it is unknown to what degree the cumulative contribution of this alternative may affect individuals. The cumulative effects considered in this analysis are not expected to affect the viability of this species.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Indicator 1

Effects expected resemble those discussed under the No Action alternative. Under Alternative 4, up to 30 acres of unsuitable habitat are proposed for reforestation within the elevation range typically used by marten. Natural, unmanaged forest development is estimated to result in an increase of habitat available to marten by 5% on NFS lands in the long-term, as discussed in the No Action alternative.

About 4,900 acres of existing plantation proposed for thinning are within the elevation range used by marten. Effects expected from plantation thinning are the same as those discussed under Alternatives 1, 3 and 5.

This alternative does not address or maximize habitat suitability and connectivity in the short or long-term for marten on this landscape. Because marten have not been documented in the project area, it is unknown if marten would be affected by implementation of this alternative or to what degree.

Indicator 2

Herbicide use is expected to have an extremely limited potential for direct or indirect toxicological effects on marten, as described under the herbicide risk assessment section.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 4 Contribution and Summary

Alternative 4 would contribute cumulatively to short and long-term effects to marten. Under this alternative, reforestation on up to 30 acres is not expected to result in measureable benefits to marten. Natural forest recovery is expected to increase available habitat by 2% across the analysis area. This is 2,460 acres less forested habitat available to marten when compared to Alternatives 1, 3 and 5. Under this alternative about 4,900 acres of existing plantation would be thinned, promoting structural diversity and improving habitat capability in the short and long-term. This alternative would result in similar benefits with respect to existing plantation thinning when compared to Alternatives 1, 3 and 5 because the thinning prescription is the same under all action alternatives. Alternative 4 would contribute to the short-term extremely limited potential of exposure to toxicity from herbicide use. Because no documented occurrences of marten in the project area, it is unknown to what degree the cumulative contribution under this alternative may affect individuals. The cumulative effects considered in this analysis are not expected to affect the viability of this species.

Pacific Marten: Summary of Effects

Indicator 1

Table 3.16-14 shows the number of acres proposed for reforestation (planting) and the number of acres of existing plantation proposed for thinning within the elevation range typically used by marten. Alternatives 1, 3 and 5 would provide more moderate to high capability habitat for marten when compared to Alternative 4. All action alternatives would result in the same amount of future moderate and high capability habitat within the treated existing plantations.

Table 3.16-14 Pacific Marten Summary of Effects: Future Moderate to High Capability Habitat

Metric	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Acres reforested[1]	3,400	0	3,400	30	3,400
Acres of existing plantation thinned	4,900	0	4,900	4,900	4,900
Total acres	**8,300**	**0**	**8,300**	**4,930**	**8,300**

[1] Includes natural regeneration.

Indicator 2

Herbicide use under Alternatives 1, 4 and 5 are expected to have an extremely limited potential for direct or indirect toxicological effects on marten because of the low Hazard Quotients related to exposure and the fact that no marten have been documented in the project area. Because Alternative 4 has fewer acres of herbicide application proposed, the potential for effects would be less than under Alternatives 1 and 5. It is important to note that the toxicity exposure scenarios analyzed in the risk assessment show that all HQs are well below the threshold of concern, and most are several orders of magnitude less than the threshold of concern or NOAEL. Marten are provided an adequate margin of safety in the event that they are exposed to contaminated prey, fruit or water.

Determinations

ALTERNATIVES 1 AND 5

Alternatives 1 and 5 may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the Pacific marten. This determination is based on the following rationale:

- These alternatives include actions to reestablish forested habitat, accelerating the time in which these areas would be suitable for resting, denning and foraging.

- These alternatives include actions to thin existing plantations, accelerating the time in which these areas would be suitable for resting, denning, and foraging.
- Habitat connectivity would be restored under these alternatives.
- Snag retention in close proximity to green forest would result in maintaining denning and resting structures as well as habitat for prey throughout the treated areas.
- LOPs for wildlife associated with similar habitat under these alternatives would reduce disturbance potential to marten.
- Toxicity exposure levels from herbicide use under these alternatives are all well below the Forest Service established threshold of concern.

ALTERNATIVE 2

Alternative 2 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the Pacific marten. This determination is based on the following rationale:

- This alternative would result in the smallest increase in moderate to high capability habitat available to marten in the long-term.
- The structural diversity of existing plantations would not be promoted and thus habitat quality would not be improved in the short-term.
- Existing plantations may be at greater risk of loss when fire returns to this landscape.
- There would be no potential for exposure to herbicides.

ALTERNATIVE 3

Alternative 3 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the Pacific marten. This determination is based on the following rationale:

- This alternative includes actions to reestablish forested habitat, accelerating the time in which these areas would be suitable for resting, denning and foraging.
- This alternative includes actions to thin existing plantations, accelerating the time in which these areas would be suitable for resting, denning and foraging.
- Habitat connectivity would be restored under this alternative.
- Snag retention in close proximity to green forest would result in maintaining denning and resting structures as well as habitat for prey throughout the treated areas.
- LOPs in place for wildlife associated with similar habitat under these alternatives would reduce disturbance potential to marten.
- There would be no potential for exposure to herbicides.

ALTERNATIVE 4

Alternative 4 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the Pacific marten. This determination is based on the following rationale:

- This alternative includes actions to thin existing plantations, accelerating the time in which these areas would be suitable for resting, denning and foraging.
- Snag retention in close proximity to green forest would result in maintaining denning and resting structures as well as habitat for prey throughout the treated areas.
- LOPs for wildlife associated with similar habitat under these alternatives would reduce disturbance potential to marten.
- Toxicity exposure levels from herbicide use under this alternative are all well below the Forest Service established threshold of concern.

Fisher: Affected Environment

Species and Habitat Account

The fisher (*Pekania pennanti,* formerly *Martes pennanti pacifica*) is a Region 5 Forest Service Sensitive species and a candidate for listing under the ESA. On October 7, 2014, the U.S. Fish and Wildlife Service (FWS) announced they were proposing to list the West Coast Distinct Population Segment (DPS) as threatened under the Endangered Species Act (USFWS 2014). The West Coast Fisher DPS includes all potential fisher habitats in Washington, Oregon and California from the east side of the Cascade Mountains and Sierra Nevada to the Pacific coast. The status review and proposed listing is a result of a multidistrict litigation settlement agreement under which the Service agreed to submit a proposed rule or a not-warranted finding to the Federal Register for the West Coast DPS of the fisher no later than the end of Fiscal Year 2014 (USFWS 2013). On April 18, 2016, the FWS withdrew their proposal to list the West Coast DPS of fisher as Threatened under the ESA (USFWS 2016). They concluded that the best scientific and commercial data available indicate that the proposed West Coast DPS of fisher does not meet the statutory definition of an endangered or threatened species because the stressors potentially impacting the proposed DPS and its habitat are not of sufficient magnitude, scope, or imminence to indicate that the DPS is in danger of extinction, or likely to become so within the foreseeable future.

Fishers have been listed with the State of California as a Species of Special Concern since at least 1986 (Williams 1986). In 2009, the California Fish and Game Commission recommended that the fisher be assessed for listing as Threatened or Endangered under the California State Endangered Species Act. Based on the recommendation CDFW conducted a 12-month review and concluded that the fisher did not merit protection under the State Endangered Species Act in 2010. An 11 March 2013 Notice of Findings stated that pursuant to court order, the FGC set aside its 15 Sep 2010 findings rejecting the petition to list, and the Pacific fisher is a candidate species for the purposes of CESA. Although they accepted additional comments regarding the status of fisher, they did not change their finding.

Fishers historically occurred in the Lassen, Plumas, Tahoe, Lake Tahoe Basin, Eldorado, Stanislaus, Sierra, and Sequoia National Forests. Zielinski and others (1995) determined that fishers remain extant in just two areas comprising less than half of the historic distribution: northwestern California and the southern Sierra Nevada from Yosemite National Park southward, separated by a distance of approximately 250 miles.

A number of southern Sierra Nevada population estimates and simulations have been conducted for fisher populations occurring across the Sequoia and Sierra National Forests, Mountain Home State Park, tribal lands, Yosemite and Sequoia/Kings Canyon National Parks. These estimates range from 100 to 600 adults (Lamberson et al. 2000; Spencer et al. 2008; Self et al. 2008).

Status and trend monitoring for fisher and marten was initiated in 2002; the monitoring objective is to be able to detect a 20% decline in population abundance and habitat (USDA 2006). This monitoring includes intensive sampling to detect population trends on the Sierra and Sequoia national forests, where the fisher currently occurs, and is supplemented by less intensive sampling in suitable habitat in the central and northern Sierra Nevada specifically designed to detect population expansion. From 2002 through 2008, 439 sites were surveyed throughout the Sierra Nevada on 1,286 sampling occasions, with the bulk of the sampling effort occurring within the Southern Sierra fisher population monitoring study area (USDA 2009).

Preliminary results indicate that fishers are well-distributed in portions of the Sequoia and Sierra National Forests; annual occupancy rates are consistently higher on the Sequoia (33.3% to 41.1%) than the Sierra (14.5% to 22.7%) (USDA 2005). Comparisons to southern Sierra Nevada survey data from the 1990’s suggest that the areal extent of occurrence for fisher may have expanded during the past 10 years (USDA 2005). Thus there has been no conspicuous difference in occupancy rates among years, and no seasonal effects on detection probabilities within the June to October sampling periods (Truex et al. 2009).

Carnivore cameras stations have been employed within suitable habitat in and near the analysis area in 2005 through 2015. No fisher detections were made as a result of these survey efforts (NRIS Wildlife database).

The project is within the historic distribution of fisher across the Sierra Nevada Bioregion. Fishers have been documented both in Yosemite National Park and south of the Merced River on the Sierra National Forest. Although their presence within the analysis area is undocumented, it is within dispersal distance of the closest known population, thus, their presence is assumed where suitable habitat exists. Because no documented den sites exist, LOPs for this species are not required for this project.

In the Sierra Nevada, fishers occur in mid-elevation forests (Grinnell et at. 1937; Zielinski et al. 1997) largely on NFS lands, below the elevations of most national parks and wilderness areas. In the southern Sierra Nevada, fishers occur sympatrically with martens at elevations of 5,000 to 8,500 feet in mixed conifer forests (Zielinski et al. 1995). The Sierra Nevada status and trend monitoring project has detected fishers as low as 3,110 feet and as high as 9,000 feet in the southern Sierra Nevada, which are considered to be extremes of the elevation range for this species (USDA 2006). Male fishers have much larger home ranges than female fishers. Home range estimates for male fishers on the Sierra and Sequoia National Forests range from about 5,400 to 15,400 acres whereas female fishers range from 1,300 to 3,500 acres (Mazzoni 2002; Thompson et al. 2011; Zielinski et al. 1997 and 2004a). These differences in home range size are attributed to size calculation techniques.

The following California Wildlife Habitat Relationships (CWHR) types occur in the project area and are considered important to fishers: generally structure classes 4M, 4D, 5M, 5D and 6 in ponderosa pine, montane hardwood-conifer, Sierran mixed conifer, red fir, white fir, Jeffrey pine and lodgepole pine (CDFW 2008). These stands are comprised of trees greater than 12 inches dbh and canopy cover greater than 40%.

Habitat connectivity across this landscape has been compromised by several large fires including the 2013 Rim Fire, the 2003 Kibbie Fire and the 1996 Ackerson and Rogge Fires. The analysis area still contains relatively high quality habitat for fisher in areas that burned at low or low-moderate intensity such as Twomile, Bourland, and Reynolds Creek, Pilot Ridge and the Crocker Meadow areas. The analysis area contains about 40,000 acres of moderate and high capability habitat on the Stanislaus. Suitable habitat was greatly reduced in the heart of the analysis area and connectivity between large tracts of unoccupied habitat on the forest and currently occupied areas in Yosemite has been further reduced. Acres of suitable habitat lost in the Rim Fire were enough to have supported up to 25 female fishers (Spencer et al. 2015). The majority of this large tract of suitable habitat and the predicted linkage area between Yosemite and the Stanislaus was rendered unsuitable based on post-fire analysis (Ibid, USDA 2014a). Spencer and others (2015) estimate that at least 14 modeled female fisher home ranges were rendered unsuitable because greater than or equal to 50% of the area burned at high severity. Figure 3.16-1 displays the pre-Rim Fire suitable female fisher home ranges modeled by Spencer and others (2015) overlaid with the high severity burn areas (greater than or equal to 50% basal area mortality), illustrating the need for restoring forested habitat across this landscape.

This habitat fragmentation has reduced the likelihood of fisher moving through or dispersing and settling into the area until natural vegetation recovery or forest management practices, such as planting, effectively reestablishes connectivity. About 72,084 acres of moderate and high capability habitat are within the cumulative effects analysis area, this includes all ownerships. A new linkage corridor was identified that is largely intact after the Rim Fire and is located to the north of the former linkage corridor, straddling Lake Eleanor and Cherry Lake (Ibid).

A road density of 0 to 0.5 miles per square mile is associated with high capability habitat for fishers (USDA 1991). A road density of 0.5 to 2.0 miles per square mile is associated with medium capability habitat (Ibid). The road density including all routes open to motor vehicles in the analysis area is 3.0 miles per square mile on National Forest Service lands and is more than six times the acceptable density found in high quality habitat and more than 1 mile per square mile above that found in moderate capability habitat.

Breeding occurs from late February through May, just a few days after giving birth to young. Den site structural elements must exist in the proper juxtaposition within specific habitats in order to provide a secure environment for birth and rearing of fisher kits. Natal dens, where kits are born, are most commonly in tree cavities at heights of greater than 20 feet (Lewis and Stinson 1998). Maternal dens, where kits are raised, may be in cavities closer to the ground so active kits can avoid injury in the event of a fall from the den (Ibid).

Truex et al. 1998, Zielinski et al. 2004, Zielinski et al. 2006, Purcell et al. 2009 characterize suitable habitat for denning/resting as follows:

- Canopy cover greater than 60%.
- Large live and dead conifers and hardwoods 21 to 51 inches dbh; showing preference for largest tree or snag in area.
- Live and snag tree basal area ranges from 100 to 500 feet² per acre.

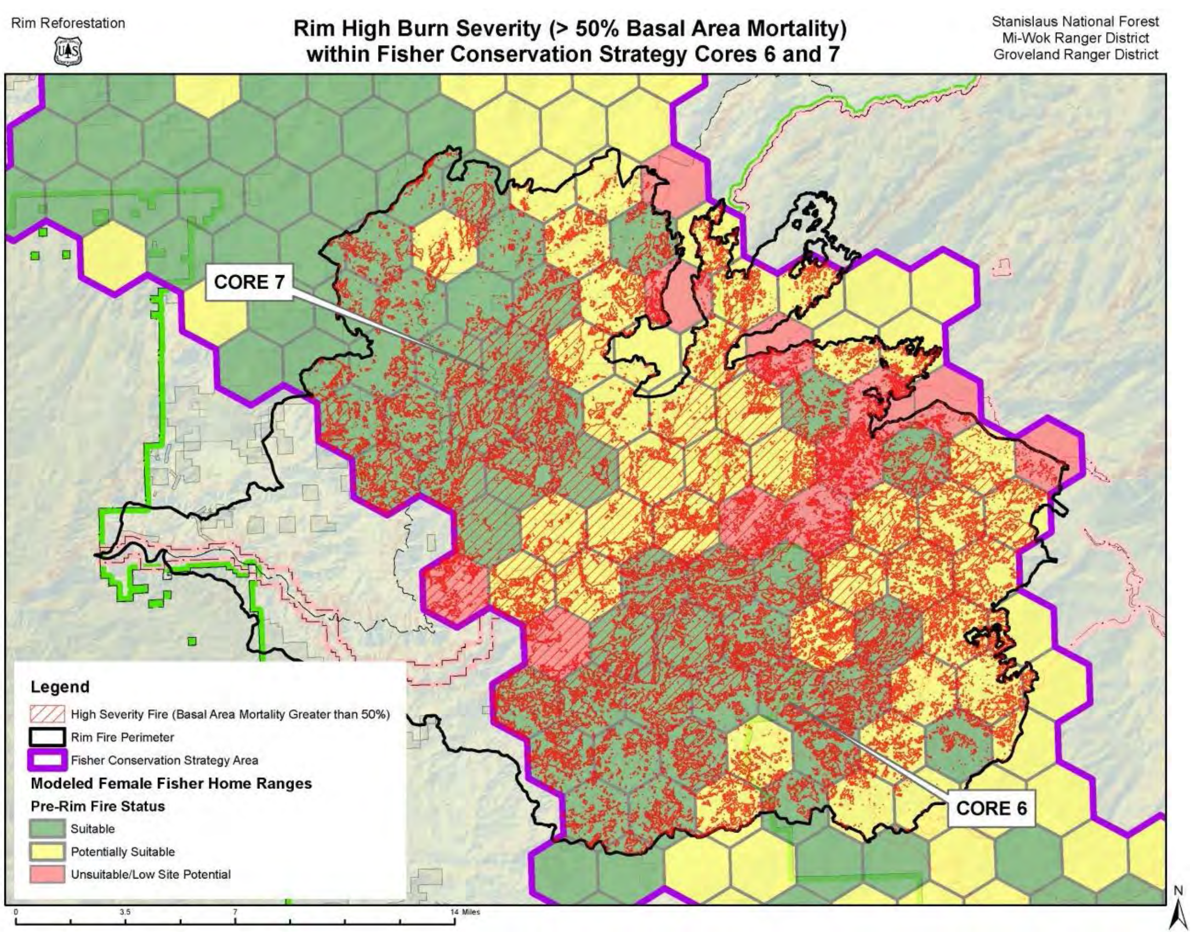

Figure 3.16-1 Pre-Rim Fire Suitable Female Fisher Home Ranges (2015)

Fishers are considered prey generalists and their diet varies widely with local prey available in the diverse habitats they occupy (Zielinski and Duncan 2004). Prey items include squirrels, voles, porcupine, snowshoe hares and reptiles (Ibid). They also readily consume hypogeous fungi, fruit and deer carrion (Ibid). While information is lacking regarding fishers use of meadows, they are known to eat meadow voles and it is likely that they forage along meadow edges as marten do.

Freel 1991 characterized highly suitable habitat for foraging as follows:

- Canopy cover greater than 40% with a shrub component in the understory.
- Largest snags average 4 to 5 per acre and are greater than 20 inches dbh.
- Downed logs average 4 per acre and are greater than 30 inches dbh.

No research is available regarding fisher use of high severity burn areas in the first few years after a fire. Fishers have been documented in shrub habitat, but their activities and time spent in this habitat are currently unknown (Thompson pers. comm.). Although not similar to the existing condition in the project area, 2 years post-fire, Hanson (2013) did look at fisher use of un-salvaged burned and unburned forest 10 to 12 years post-fire. Specific vegetative conditions along sampled transects at the time of the study were not presented; only the pre-fire CWHR vegetation type, size and density class were used. Thus it is unclear what the existing vegetative conditions were at the time of the study, such as understory vegetation composition and cover. Hanson (2013) found that fisher selected mixed-conifer forest in both post-fire habitat and unburned forest 10 to 12 years post-fire. Although fisher did use pre-fire dense, mature forest more than expected, the results were not significant. More research is needed to clarify fisher use and the value of burned habitat for this species (Spencer et al. 2015).

Dispersal ability is low in the western population and Arthur and others (1993) suggest that short dispersal distances (from 6 to 12 miles from natal home range) may be problematic in the maintenance of suitable fisher populations in areas where suitable habitat is fragmented. The current disjunct distribution pattern may also be partially attributed to movement and dispersal constraints imposed by the elongated and peninsular distribution of montane forests in the Pacific states (Wisely et al. 2004). The synergistic effect of road and rodenticide related mortalities documented in the southern Sierra populations, the apparent reluctance of fishers to cross open areas and the more limited mobility of this terrestrial mammal, make it more difficult for fishers to locate and occupy distant, but suitable, habitat.

RISK FACTORS

1. *Uncharacteristically Severe Wildfire*: High severity wildfires have been increasing in number and intensity over the past several decades and this trend is predicted to continue. For example, the Rim Fire of 2013 removed 28,205 acres of moderate and high capability habitat, as defined above. Many fires within the current range of the fisher have resulted in the destruction of important denning, resting and foraging habitat. Spencer et al. (2008) found that the short-term negative localized effects to fisher from active vegetation management designed to reduce high severity wildfire in and near suitable habitat would out-weigh the positive long-term effects of protecting suitable fisher habitat.

2. *Vegetation Manipulation to Reduce Risk of Uncharacteristically Severe Wildfire*: Aggressive stand thinning for forest health and reduced fire risk may remove important cover, snags and vegetative diversity for fisher. These treatments may prevent more adverse effects associated with drought and wildfire, but may nonetheless leave habitat with reduced value for fisher or even render it unsuitable.

3. *Habitat Fragmentation, Loss of Connectivity*: Habitat connectivity is 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.

4. *Climate Change*: Climate change is a concern for fishers because of the widespread ecological effects. There is the potential that climate change could increase habitat quality for this species, but various models and studies appear to support the idea that the core habitat for fisher in the middle elevation would suffer from fires and disease.

Fisher: Environmental Consequences

The project alternatives could result in direct and indirect effects to the fisher through the following activities:

- Mechanical site preparation for planting.
- Herbicide application for site preparation, release of conifers and noxious weed applications.
- Planting and thinning conifers.

These direct and indirect effects include:

- Project related death, injury and disturbance.
- Project related modifications to habitat quantity or quality.

Death, Injury and Disturbance

Death or injury from project related activities would be unlikely to occur given the mobility of this species. However, if a den or rest tree were felled while being used by fisher death or injury could occur. Project activities, especially loud noise, could result in disturbance that may impair essential behavior patterns of the fisher related to denning, resting or foraging. Loud noise from equipment such as chain saws or tractors is expected to occur in treatment units. The location of fisher within the analysis area is uncertain following the 2013 Rim Fire, a large- scale disturbance event; but surveys conducted to date have resulted in no detections of fisher in the project area. This is consistent with Regional monitoring that has resulted in no detection of fisher on the Stanislaus. Temporary avoidance of the project site or displacement of individuals is expected during project implementation. Any displacement or avoidance would be of short duration and would subside shortly after project implementation activities. LOPs in place for spotted owls, goshawks and great gray owls would afford protection to individual fisher in these areas during parturition, kit rearing and subsequent breeding (March through August). The potential risk to individual fisher is considered low because of the lack of documented fisher occurrence within or near the analysis area.

Habitat Modification

Reforesting areas that burned at high severity would accelerate development of contiguous forested habitat, increasing the amount of habitat available and restoring connectivity across the landscape. These reforestation efforts are largely located within the Fisher Conservation Strategy Area, an area identified as an integral part of southern Sierra fisher conservation and northern expansion (Spencer et al. 2015). Active or managed reforestation is predicted to provide more complex habitat conditions in the long-term. For, example, active reforestation is expected to produce more large trees (e.g., greater than or equal to 24 inches dbh) and higher levels of snag recruitment when compared to the No Action Alternative. Thinning existing plantations is also expected to accelerate growth rates and increase structural stand diversity, improving foraging and breeding habitat conditions sooner. Thinning these areas would also increase resilience when managed or wildfire returns to this landscape (3.05 Fuels). Reducing fragmentation across the landscape and increasing the amount of interior forest is likely to increase habitat effectiveness and use by dispersing and future resident fisher. While restoring the lost habitat and linkage area near the Tuolumne and Clavey River Canyons will take many decades, reforesting this area would provide long-term benefits. These benefits include; increasing habitat availability to support several breeding females and decreasing the bottleneck created by the Rim Fire where habitat and linkage between current populations in the south to suitable yet unoccupied habitat to the north is very limited.

Retention of snags and large downed woody debris is proposed under all action alternatives. Retention of snags within and near suitable fisher habitat (green forest) would provide denning and resting sites as well as habitat for prey species (Freel 1991; Thompson et al. 2011; Zielinski et al. 2004). The number of snags and downed logs available across a fisher's home range affects the quality of habitat for foraging and breeding. Because resting and denning structures are likely the most limiting habitat elements within fisher home ranges, retaining these elements across the landscape is critical (Ibid).

No research is available regarding fisher use of high severity burn areas in the first few years after fire, fishers have been documented in shrub habitat, but their activities and time spent in this habitat is currently unknown (Thompson pers. comm.). Hanson (2013) looked at fisher use in burned versus unburned habitat in the McNally and Manter fire footprints 10 to 12 years post-fire in an area that was not salvage logged. They report that fishers were using habitat that burned at moderate and high severity greater than 500 meters from the edge of unburned forest habitat, although these findings were not significant. The vegetative conditions of this research do not mimic the existing condition within the Rim Fire area because they are two-years post-fire, not 10 to 12 years post-fire. Prey species that tolerate disturbance or open conditions are known to be abundant in post fire environments, such as mice, rats, chipmunks and squirrels (Amacher et al. 2008; Diffendorfer et al. 2012). Structural elements such as snags and downed logs, when combined with the flush of shrubs, forbs and grasses returning post-fire, could provide habitat suitable for prey and foraging within a few years; however, more research is needed to clarify fisher use and the value of burned habitat for this species (Spencer et al. 2015). Reforestation efforts may result in the short-term removal of a small fraction of potential foraging habitat (i.e. burned forest in close proximity to green forest edge); however, currently, no documented fishers occur in the project area and the risk of effects to individuals is considered extremely low.

Large snags and large downed logs are considered biological legacies in a post fire environment and play important roles in the structure of future forest (Lindenmayer et al. 2008). Large snags and downed logs may take hundreds of years to develop, emphasizing the need to retain these elements across the landscape. Snag fall and decay rates vary considerably by species and can remain standing for decades (Cluck and Smith 2007; Ritchie et al. 2013). When snags eventually fall, they are incorporated as large downed logs, another critical structural element important for fisher and prey species (Freel 1991; Zielinski et al. 2004a).

Indicators

The following indicators were chosen to provide a relative measure of the direct and indirect effects to the fisher and to determine how well project alternatives comply with Forest Plan Direction and the Draft Conservation Strategy (Spencer et al. 2015). These criteria were chosen based on the best available scientific literature which focuses on various aspects of fisher ecology and life history requirements. These criteria focus on those life history aspects, or habitat elements, considered most limiting to fisher persistence across their range and where project effects are expected.

1. Acres of future moderate and high capability habitat planted and thinned.
2. Toxicological effects from herbicide use.

Alternatives 1, 3 and 5

Because the areas proposed for reforestation and thinning are the same under these three alternatives, the effects are expected to be similar and are analyzed together. The differences in herbicides proposed between Alternatives 1 and 5 versus Alternative 3 were separated below accordingly.

DIRECT AND INDIRECT EFFECTS

Indicator 1

Reforestation and Natural Regeneration

Habitat availability and connectivity was much reduced by the Rim Fire and the proposed reforestation would restore a significant portion of lost habitat. Under these alternatives, about 23,800 acres are within the Fisher Conservation Strategy Area. Planting conifers as prescribed under these alternatives would result in the restoration of moderate and high capability forested habitat across the landscape. Reforestation under these alternatives would result in increasing the amount of moderate and high capability habitat available to fisher by 59% on NFS lands in the long-term.

Thinning

About 8,000 acres of existing plantation are within the Fisher Conservation Strategy Area. While some of these plantations are considered suitable because they are CWHR size class 4 or 5 and have greater than 40% canopy cover, they lack structural diversity. Thinning these plantations would promote vertical and horizontal diversity which in turn improves habitat capability. Prescribed fire would be the first tool used for thinning these stands. Mechanical thinning prescriptions for these plantations focus on using an ICO design that would provide structural diversity where it does not currently exist. For example, the prescription calls for releasing oaks and retaining diverse conifer species and sizes. After thinning, remaining trees are expected to grow faster and the amount of understory vegetation would increase and diversify, improving habitat conditions for fisher and their prey in the short and long-term. By breaking up the continuity of vegetation across a given area, the habitat would be more resilient when fire returns to this landscape (3.05 Fuels).

Reforestation and thinning treatments proposed under these alternatives would begin the restoration of habitat that could support several female fishers in the future. These alternatives address and maximize habitat suitability and connectivity in the long-term for fisher at home range and landscape scales, increasing connectivity within the Fisher Conservation Strategy Area Cores 6 and 7 as well as pre-fire linkage area. Although fishers have not been recently documented in the project area, benefits could be realized if and when they occupy this landscape in the future.

Indicator 2

Under Alternatives 1 and 5, herbicide use is expected to have an extremely limited potential for direct or indirect toxicological effects on fisher, as described under the herbicide risk assessment section. Because no herbicides are proposed under Alternative 3, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to fisher would occur under this alternative.

CUMULATIVE EFFECTS

Appendix B identifies the present and reasonably foreseeable future actions on all lands within the analysis area. Some, but not all of these actions have or may contribute cumulatively to effects on fisher.

Based on risk factors affecting fishers, the following evaluation criteria were used as relative measures of cumulative effects from Alternatives 1, 3 and 5: habitat modification. In addition, Alternatives 1 and 5 used toxicological effects for evaluation criteria.

Habitat Modification

Federal Lands

Present and foreseeable future activities on federal lands include: Funky Stewardship, Groovy Stewardship, Reynolds Creek Stewardship, Soldier Creek Timber Sale, Campy Timber Sale, Looney Timber Sale, Thommy Timber Sale, which are green thinning projects treating 6,100 acres of forest across the analysis area. All snags and many declining trees will be retained unless they pose a safety hazard. The snag and declining tree retention will provide snags that could serve as potential denning or resting sites for fishers in the short-term as well as recruits for future denning or resting sites in the long-term. One other federal activity potentially impacting habitat for fishers is fuels reduction associated with the Rim Recovery project which will reduce the risk of further loss of remaining green forest within the project area.

Toxicological Effects

Federal Lands

There is one present federal action of herbicide use on 0.5 acres under the Rim Fire Rehabilitation project and two foreseeable federal actions of herbicide use: 8.0 acres under the Twomile Ecological Restoration Noxious Weed project and 23 acres under a special use permit for the Reliable Power Project powerline. No other present or foreseeable future federal actions are related to herbicide use.

Private Lands

Herbicide use is proposed on 1,583 acres of private land within the project area in 2017. No other present or foreseeable future actions are proposed on private lands related to herbicide application.

Alternatives 1, 3 and 5 Contribution and Summary

Alternatives 1, 3 and 5 would contribute cumulatively to short and long-term effects to fishers. Under these alternatives, reforestation on about 23,800 acres would provide the most suitable resting, denning and foraging habitat when compared to Alternative 4. The cumulative contribution of reforestation under Alternatives 1, 3 and 5 would result in a 33% increase in moderate and high capability habitat available across the analysis area in the long-term. Under these alternatives about 8,000 acres of existing plantation would be thinned, promoting structural diversity and improving habitat capability in the short and long-term. These alternatives would result in similar benefits with respect to existing plantation thinning when compared to Alternative 4 because the thinning prescription is the same under all action alternatives. Alternatives 1 and 5 would contribute to the short-term limited potential of exposure to toxicity from herbicide use. Because no documented occurrences of fishers exist within the project area, it is unknown to what degree the cumulative contribution would be under these alternatives to affect individuals. The cumulative effects considered in this analysis have the potential to beneficially affect the viability of this species.

Alternative 2

DIRECT AND INDIRECT EFFECTS

Indicator 1

The indirect effects of no action are primarily related to the influence no action may have on the amount of suitable forested habitat available to fishers in the long-term. Under this alternative, only about 9,800 acres of natural regeneration is predicted to occur within the Fisher Conservation Strategy Area. This would increase habitat availability across NFS lands by 24%, almost two thirds less than that expected under Alternatives 1, 3 and 5. Because no active management is proposed, it is unknown where naturally regenerating forest would occur, how long it would take to develop and what benefits it would provide fishers. Research and monitoring data from the project area show that areas in close proximity to live trees (i.e. seed source) would experience forest expansion to a limited degree, depending on the competing vegetation in the localized area (Bonnet et al. 2005). It should be noted that natural conifer expansion is sporadic in nature, could be delayed for decades due to shrub suppression, would likely be dominated by fir and would not result in significant gains in forested habitat (3.13 Vegetation). Areas far from seed sources would likely persist as chaparral for decades if not well over a hundred years. Existing plantations would not be thinned under this alternative; therefore, no increase in structural diversity or improvement of habitat quality would occur. The plantations, if left untreated, could be at greater risk of loss when fire returns to this landscape because of the tightly spaced live trees and existing fuel loads (3.05 Fuels). Habitat connectivity would not be restored in critical areas such as the Tuolumne River Canyon, which was considered the most likely route for fisher dispersal and movement between large tracts of suitable habitat prior to the Rim Fire (Spencer et al. 2015). This alternative could result in a small increase in long-term habitat available to fishers on NFS lands.

Indicator 2

Because no herbicides are proposed under Alternative 2, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to fisher would occur under this alternative.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 above outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 2 Contribution and Summary

Under Alternative 2, no direct effect is expected because no active management would occur, however, there may be indirect consequences primarily related to the influence no action may have on future forest development and how that may impact fishers. At the landscape scale, the cumulative contribution under this alternative would potentially increase the available suitable habitat by up to 14% compared to a 33% increase under Alternatives 1, 3 and 5. Because there are no documented occurrences of fishers in the project area, it is unknown if or to what degree the cumulative contribution under this alternative may affect individuals or the viability of this species.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Indicator 1

Reforestation and Natural Regeneration

Under Alternative 4, about 2,950 acres are proposed for reforestation within the Fisher Conservation Strategy Area. This is 20,850 acres less than proposed under Alternatives 1, 3 and 5. The planting prescription under this alternative is termed founder stands. This prescription calls for small variable shaped planting areas ranging from two to ten acres in size within a larger unplanted area. The unplanted area would likely be comprised of chaparral with scattered oaks. The planted area is only 20% of a given unit. Herbicides would be used to control shrubs and competing vegetation within planted areas and incorporate a 50 foot buffer around planted areas. These trees would be planted with a much tighter spacing, groups of 5 trees spaced 6 feet from each other. With the tighter spacing of planted trees, it may be necessary to thin trees sooner. Prescribed fire would be applied to 50% of planted areas within ten years and the other 50% within 20 years. Reforesting in this manner would result in several small fragmented patches of forested habitat no bigger than ten acres separated by large tracts of chaparral. Small patches of forested habitat covering 20% of a given area would not provide the moderate and high capability habitat required by fishers, which includes large tracts of contiguous forest. Similar to the No Action Alternative, about 9,800 acres of forested habitat is predicted to develop naturally with no active management across the landscape. Because no active management would occur on these acres, it is unknown where naturally regenerating forest would occur and what benefits it would provide for fishers. It is likely that areas in close proximity to live trees (i.e. seed source) would experience forest expansion to a limited degree, depending on the competing vegetation in the localized area. As stated under the No Action Alternative, natural conifer expansion is sporadic, could be delayed for decades, would likely be dominated by fir and would not result in significant gains in forested habitat (3.13 Vegetation). Areas far from seed sources would likely persist as chaparral for decades if not well over a hundred years. While this alternative would increase the amount of forested habitat across NFS lands by up to 24%, it is unknown how fragmented or contiguous the distribution would be and if it would provide benefits to fishers at the home range or landscape scale.

Thinning

About 8,000 acres of existing plantation proposed for thinning are within the Fisher Conservation Strategy Area. Effects expected from plantation thinning are the same as those discussed under Alternatives 1, 3 and 5.

In summary, this alternative does not address or maximize habitat suitability and connectivity in the short or long-term for fishers at the home range or landscape scale. Because fishers have not been recently documented in the project area, it is unknown if fishers would be affected by implementation of this alternative or to what degree.

Indicator 2

Herbicide use is expected to have an extremely limited potential for direct or indirect toxicological effects on fisher, as described under the herbicide risk assessment section.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 4 Contribution and Summary

Alternative 4 would contribute cumulatively to short and long-term effects to fishers. Under this alternative, reforestation on up to 2,950 acres in discrete, fragmented patches is not expected to result in any measureable benefits to fishers. Reforestation and natural forest recovery under this alternative is expected to increase available habitat by up to 14% across the analysis area. However, this natural forest recovery is expected to be sporadic, delayed and provide a limited contribution to moderate and high capability habitat in the long-term. The founder stands prescription is not expected to provide moderate and high capability habitat because it would be located in small fragmented patches separated by large tracts of chaparral. Under this alternative about 8,000 acres of existing plantation would be thinned, promoting structural diversity and improving habitat capability in the short and long-term. This alternative would result in similar benefits with respect to existing plantation thinning when compared to Alternatives 1, 3 and 5 because the thinning prescription is the same under all action alternatives. Alternative 4 would contribute to the short-term potential of exposure to toxicity from herbicide use, but this would be extremely limited. Because no documented occurrences of fishers exist in the project area, it is unknown to what degree the cumulative contribution under this alternative may affect individuals. The cumulative contribution under this alternative would not result in beneficial effects to the viability of this species.

Fisher: Summary of Effects

Indicator 1

Table 3.16-15 displays the number of acres proposed for reforestation (planting) and the number of acres of existing plantation proposed for thinning within the Fisher Conservation Strategy Area. Alternatives 1, 3 and 5 would provide more moderate to high capability habitat for fishers when compared to Alternative 4. Habitat provided under Alternatives 1, 3 and 5 would consist of large tracts of contiguous forest, reducing fragmentation across the landscape. Habitat provided under Alternative 4 would be much more fragmented, reducing its effectiveness for fishers. All action alternatives would result in the same amount of future moderate and high capability habitat within the treated existing plantations.

Table 3.16-15 Fisher Summary of Effects: Future Moderate to High Capability Habitat

Metric	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Acres reforested[1]	23,800	0	23,800	2,950	23,800
Acres of existing plantation thinned	8,000	0	8,000	8,000	8,000
Total acres	**31,800**	**0**	**31,800**	**10,950**	**31,800**

[1] Includes natural regeneration

Indicator 2

Herbicide use under Alternatives 1, 4 and 5 are expected to have an extremely limited potential for direct or indirect toxicological effects on fisher because of the low Hazard Quotients related to exposure and no fishers have been documented in the past several decades within the project area. Because Alternative 4 has fewer acres of proposed herbicide application, the potential for effects would be less than under Alternatives 1 and 5. It is important to note that the toxicity exposure scenarios analyzed in the risk assessment show that all HQs are well below the threshold of concern, and most are several orders of magnitude less than the NOAEL. Fishers are provided an adequate margin of safety in the event that they are exposed to contaminated prey, fruit or water.

Determinations

ALTERNATIVES 1 AND 5

Alternatives 1 and 5 may affect but are not likely to jeopardize the continued existence of the fisher. This determination is based on the following rationale:

- These alternatives include actions to reestablish contiguous forested habitat, accelerating the time in which these areas would be suitable for resting, denning and foraging.
- These alternatives include actions to thin existing plantations, accelerating the time in which these areas would be suitable for resting, denning and foraging.
- Habitat connectivity would be restored under these alternatives.
- Snag retention in close proximity to green forest would result in maintaining denning and resting structures as well as habitat for prey throughout the treated areas.
- LOPs for wildlife associated with similar habitat under these alternatives would reduce disturbance potential to fishers.
- Toxicity exposure levels from herbicide use under these alternatives are all well below the Forest Service established threshold of concern.

ALTERNATIVE 2

Alternative 2 may affect but is not likely to jeopardize the continued existence of the fisher. This determination is based on the following rationale:

- This alternative would result in the smallest increase in moderate to high capability habitat available to fishers in the long-term.
- The structural diversity of existing plantations would not be promoted and thus habitat quality would not be improved in the short-term.
- Existing plantations may be at greater risk of loss when fire returns to this landscape.
- There would be no potential for exposure to herbicides.

ALTERNATIVE 3

Alternative 3 may affect but is not likely to jeopardize the continued existence of the fisher. This determination is based on the following rationale:

- This alternative includes actions to reestablish contiguous forested habitat, accelerating the time in which these areas would be suitable for resting, denning and foraging.

- This alternative includes actions to thin existing plantations, accelerating the time in which these areas would be suitable for resting, denning, and foraging.
- Habitat connectivity would be restored under this alternative.
- Snag retention in close proximity to green forest would result in maintaining denning and resting structures as well as habitat for prey throughout the treated areas.
- LOPs for wildlife associated with similar habitat under these alternatives would reduce disturbance potential to fishers.
- There would be no potential for exposure to herbicides.

Alternative 4

Alternative 4 may affect but is not likely to jeopardize the continued existence of the fisher. This determination is based on the following rationale:

- This alternative includes actions to establish small fragmented patches of forest that would not provide suitable resting, denning, or foraging habitat.
- This alternative includes actions to thin existing plantations, accelerating the time in which these areas would be suitable for resting, denning, and foraging.
- Snag retention in close proximity to green forest would result in maintaining denning and resting structures as well as habitat for prey throughout the treated areas.
- LOPs for wildlife associated with similar habitat under these alternatives would reduce disturbance potential to fishers.
- Toxicity exposure levels from herbicide use under this alternative are all well below the Forest Service established threshold of concern.

Fisher: Consistency with the Fisher Conservation Strategy

Applicable Conservation Measures from the Conservation Strategy

Objective 1.1: Increase the geographic extent of occupied fisher habitat, especially via northward expansion into currently unoccupied habitat cores.

Conservation Measure: Manage for increased quality and quantity of fisher habitat, and mitigate dispersal impediments.

Objective 1.2: Maintain or increase fisher carrying capacity within each core area.

Conservation Measure: Manage vegetation to restore fine-scale habitat heterogeneity, promote denning habitat quality and extent, retain and recruit essential fisher habitat elements, increase and diversify the fisher prey base, promote growth and recruitment of black oaks, and increase forest resilience to climate change and disturbance events.

Objective 2.1: Increase dispersal potential within and between core habitat areas.

Conservation Measure: Where site conditions permit in delineated linkage areas, maintain or increase tree canopy cover and retain and promote recruitment of downed logs, standing trees, and shrub patches to provide hiding and escape cover in non-forested portions; prevent new impediments to movement (e.g., wide openings, reservoirs); protect linkage areas from stand-replacing fire.

Objective 3.1: Improve fisher habitat resiliency and restore fire as a key ecological process.

Conservation Measure: Reduce hazardous fuel conditions and increase habitat heterogeneity patterns that reflect how topography, soil, and other factors affect vegetation characteristics and fire behavior; implement ecological restoration concepts described in GTR 220/237 to promote conditions that allow fire to serve its natural ecological role in maintaining resilient and heterogeneous forest conditions; maximize use of prescribed fire or wildfire managed for resource benefits at large scales and under conditions that promote resiliency and fisher habitat values.

Objective 3.2: Maintain or increase important fisher habitat elements.

Conservation Measure: Retain and promote recruitment of large trees, coarse woody debris (large snags and logs), trees with cavities and other defects, large black oaks, dense tree clusters and gaps at fine (less than 0.5 acres) resolution and clumps of multi-storied tree canopies.

Consistency with the Fisher Conservation Strategy

Alternatives 1, 3 and 5 manage for contiguous forested habitat and connectivity across the landscape through reforestation within about 80 years.

Alternative 4 manages for small fragmented patches of forested habitat no larger than ten acres each across the landscape within about 80 years.

Alternatives 1, 3, 4 and 5 manage for heterogeneity, promoting retention of fisher habitat elements, releasing black oaks and increasing habitat resilience by thinning existing plantations.

Alternatives 1, 3, 4 and 5 manage for heterogeneity, planting multiple conifer species including pine, cedar and fir, and buffering oaks when planting.

Alternatives 1 and 3 manage for heterogeneity that reflects topography, soil and other factors highlighted in GTR 220/237 by using different prescriptions and desired conditions where appropriate on the landscape that implement these concepts.

Alternative 5 manages for heterogeneity that reflects topography, soil and other factors highlighted in GTR 220/237 by using different prescriptions, pre-commercial thinning treatments and desired conditions where appropriate across the landscape that implement these concepts.

Alternatives 1, 3, 4 and 5 manage to reduce hazardous fuels, increase habitat heterogeneity reflecting topography, soil and other factors as highlighted in GTR 220/237 by thinning using the ICO concept and introducing prescribed fire to existing plantations.

Alternatives 1, 3, 4 and 5 promote retention of large trees (conifers and black oaks), snags and logs, trees clusters and gaps (ICO) and multi storied canopies in existing plantations.

Alternatives 1, 3, 4 and 5 manage to retain large snags and logs in reforestation units to contribute to the development of future forest.

Fringed Myotis, Pallid and Townsend’s Big-Eared Bat: Affected Environment

Species and Habitat Accounts

The pallid bat (*Antrozous pallidus*) is a Region 5 Forest Service Sensitive species and is designated as a Species of Special Concern by CDFW. They occur in arid regions of western North America from British Columbia to Mexico and east to Wyoming (Hermanson and O’Shea 1983). They are usually found in low to mid elevation habitats below 6,000 feet; however, they have been documented up to 10,000 feet in the Sierra Nevada (USDA 2001). Considered yearlong residents, they inhabit vegetation types such as Blue Oak Woodland, Mixed Chaparral, and coniferous forests (CDFW 2014b, Baumbach pers. obs.).

The fringed myotis (*Myotis thysanodes*) is a Region 5 Forest Service Sensitive species and is designated as a Species of Special Concern by CDFW. The fringed myotis occurs from southern British Columbia south through the western United States and most of Mexico (O’Shea and Bogan 2003). In California, it occurs from near sea level at the coast to elevations of at least 6,400 feet in the Sierra Nevada and in a variety of habitats from low desert scrub to high-elevation conifer forest (Philpott 1997). The fringed myotis is a widely distributed species, but it is considered rare (Ibid). Although this species occurs in netting and night roost surveys in a number of localities, it is always one of the rarest taxa (Pierson et al. 1996).

The Townsend's big-eared bat (*Corynorhinus towsendii*) is a Region 5 Forest Service Sensitive species and is designated as a candidate for Threatened status under the California Endangered Species Act (CESA). They occur in low desert to mid-elevation montane habitats throughout the west and are distributed from the southern portion of British Columbia south along the Pacific Coast to central Mexico and east into the Great Plains, with isolated populations occurring in the south and southeastern United States (Kunz and Martin 1982). They can be found from sea level to 10,000 feet elevation and are considered yearlong residents. Their distribution in California is strongly correlated with limestone caves, old mines, and abandoned buildings (Ibid, USDA 2001). In the Sierra Nevada, they are associated with vegetation types such as Blue Oak Woodland, Sierran Mixed Conifer, and Montane Riparian (CDFW 2008).

The status of pallid, fringed myotis and Townsend bat populations is not well researched, but all populations are thought to have declined over the past several decades (Williams 1986, Macfarlane and Angerer draft, O'Shea and Bogan 2003). Data from California suggest population declines associated with habitat loss and destruction along with disturbance at roost sites have contributed to reduced or lost occupancy at historic sites (Ibid and O'Shea and Bogen 2003, USDA 2001).

Bat surveys have been conducted in and near the analysis area. Pallid bats have been documented on the North Fork Merced River and along Cottonwood Creek (project record). Fringed myotis have been documented at Fahey Pond and the Hetch-Hetchy adit at the end of road 1N45 (CNDDB, USDA 2015e). They have also been documented just outside the analysis area in the lower Tuolumne River and a bridge over the South Fork Tuolumne River. All documented occurrences of Townsend's big-eared bats in the vicinity of the Rim Fire were in caves, mines, and bridges (CNDDB database, Pierson and Fellers 1998, Pierson et al. 2001). One maternity colony has been documented on the NFS system lands, Bower Cave; about three miles west of the fire perimeter. Suitable roosting and foraging habitat is present throughout the project area and presence of all three species is assumed.

Pallid bats are common in open, dry habitats including grasslands, shrublands, woodlands, and coniferous forests. They roost in a variety of locations such as bridges, buildings, caves, rock crevices, mines, and trees (Hermanson and O'Shea 1983). This species can be found singly but is gregarious and can often be found roosting in groups. They are sensitive to roost site disturbance which may lead to roost abandonment. Suitable habitat is present throughout the project area. No barriers exist precluding movement (dispersal, seasonal, etc.) of this species both within and in close proximity to the project area.

In California, the fringed myotis occurs in valley foothill hardwood, hardwood conifer, and coniferous forested habitats. In mist netting surveys, they are found on secondary streams and ponds (USDA 2015e). They roost in caves, buildings, mineshafts, rock crevices and bridges (O'Farrell and Studier 1980). Studies conducted in California, Oregon, and Arizona, have documented that fringed myotis roosts in tree hollows, particularly in large conifer snags (Chung-MacCoubrey 1996; Rabe et al. 1998; Weller and Zabel 2001; Pierson et al. 2006). Most of the tree roosts were located within the tallest or second tallest snags in the stand and were surrounded by reduced canopy closure (Ibid). They are gregarious and can be found roosting with other bat species, such as the long eared myotis (M. Baumbach pers. obs.). They exhibit high roost site fidelity, sometimes in different trees but within a small area (O'Farrell and Studier 1980; Weller and Zabel 2001). Fringed myotis are highly sensitive to roost site disturbance (Ibid).

Townsend's bats are uncommon and can be found in close association with limestone caves and abandoned mines. They readily forage in meadow habitat, often associated with willows (M. Baumbach pers. obs.). They can also be found in other habitats including oak woodlands, grasslands, and riparian corridors. Although documented to occasionally use basal hollows of trees in coastal forest dominated by redwood, Douglas fir, and California bay (Fellers and Pierson 2002), this has not been documented in the Sierra Nevada. Snag habitat is not considered typical roosting habitat for this species and a reduction in snag habitat has not been identified as a significant threat to this species (Philpott 1997, Region 5 species account). While they're not considered gregarious, they can be found roosting singly or together with big-eared bats and other species. No barriers precluding movement (dispersal, seasonal, etc.) exist both within and in close proximity to the project area.

All three species breed in the fall with delayed implantation occurring in the spring. Females form maternity colonies in spring (Zeiner et al. 1990). Pallid bats prefer horizontally-oriented rock crevices as diurnal roost sites in the summer, which coincides with maternity colony selection and use (Hermanson and O'Shea 1983). Townsend's bats select the warm parts of caves, mines, and buildings for their maternity roosts (Kunz and Martin 1982).

Pallid bats forage in open canopied woodlands, riparian areas, and grassland or meadow habitat. They are maneuverable on the ground and commonly forage between one and five feet above the ground for prey such as Jerusalem crickets, longhorn beetles, scorpions, and occasionally large moths and grasshoppers (USDA 2001, Zeiner et al. 1990). They readily use roads, meadows, oak woodlands and other open areas to hunt.

Fringed myotis emerge from roost sites to forage approximately 1-2 hours after sunset. They forage in and among vegetation along forest edges and in the overstory canopy. They feed on a variety of insect prey, including small beetles, moths, and fly larvae caught in flight or gleened from vegetation (Ibid). Fringed myotis often forage in meadows and along secondary streams, in fairly cluttered habitat. (Pierson et al. 2001). They are known to fly during colder temperatures, precipitation, and even snow (Hirshfeld and O'Farrell 1976; O'Farrell and Studier 1975; M. Baumbach pers. obs.). Keinath (2004) found that travel distances from roosting to foraging areas may be up to five miles.

Townsend's take primarily lepidopteron (moth) prey and are known as moth specialists (Kunz and Martin 1982; Zeiner et al. 1990). They forage along forested edges and vegetated stream corridors (Ibid).

Dispersal patterns for pallid, fringed myotis and Townsend's bats are unknown and they are not known to migrate long distances. Pearson et al. (1952) documented an individual Townsend's male that travelled 20 miles. Movements between Townsend maternity colonies and hibernacula have been documented from 1.9 to 24.6 miles (Ibid). Pallid and Townsend's big-eared bats are relatively inactive and either hibernate or enter extended periods of torpor during the winter (Hermanson and O'Shea 1983; Kunz and Martin 1982). Fringed myotis are known to hibernate, but are also capable of periodic winter activity (Philpott 1997).

RISK FACTORS

1. *White Nose Syndrome*: The largest emerging threat to all cave-roosting species is the fungal disease white-nose syndrome (WNS). Massive die-offs result once a colony is infected. Because pallid, fringed myotis and Townsend's big-eared bats readily use caves for roosting, they are considered highly susceptible to contracting WNS. Although not yet documented in California, this disease is moving to the west.
2. *Timber Harvest and loss of snags as roosting sites*: The loss of large diameter snags and live trees for roosts due to fire or harvest activities can affect roost availability for pallid bats and fringed myotis. In some forested settings, the fringed myotis appears to rely heavily on tree cavities and crevices as roost sites (Weller and Zable 2001), and may be threatened by certain timber harvest practices that result in the removal of snags. Retention of existing large trees and management of forested habitat will provide short and long-term habitat.
3. *Fire Suppression*: Pallid bats are at risk from loss of open foraging habitat from fire suppression may reduce foraging habitat in the long-term.

4. *Mining*- The resurgence of gold mining in the West potentially threatens mine dwelling bat species such as fringed myotis, pallid and Townsend's big-eared bats (Macfarlane and Angerer draft). Recreational mining exploration has resulted in an increase in roost disturbance and abandonment. Closure of old mines for hazard abatement or safety can reduce habitat availability if mines are not closed using bat friendly gates.
5. *Rangeland management*: Pallid bats frequently forage in open areas such as oak woodlands. Fringed myotis frequently forage along riparian corridors or over meadows. Overgrazing and trampling may alter meadow hydrology or riparian ecosystems, resulting in reduced insect diversity, productivity and reduced foraging success (Macfarlane and Angerer draft, Ferguson and Azerrad 2004).

Fringed Myotis, Pallid and Townsend's Big-Eared Bat: Environmental Consequences

The action alternatives could result in direct and indirect effects to Townsend's big-eared bats, pallid bats, or fringed myotis through the following activities:

- Mechanical site preparation for planting.
- Herbicide application for site preparation, release of conifers, and noxious weed applications.
- Biomass removal and similar fuel treatments.
- Planting conifers.

These direct and indirect effects include:

- Project related death, injury and disturbance.
- Project related modifications to habitat quantity or quality.

Death, Injury and Disturbance

Death or injury from project related activities would be unlikely to occur given the mobility of this species. However, death or injury could occur if a day roost tree were felled while being used by pallid bats or fringed myotis.

Project activities, especially loud noise, could result in disturbance to day roosting bats. Loud noise from equipment such as chain saws or tractors is expected to occur in treatment units. Smoke from pile or prescribed burning may also impact bats that are roosting in close proximity to burning activities. The location of these species within the analysis area is uncertain, but presence is assumed. While these species are susceptible to disturbance at roost sites that may lead to roost abandonment, it is unlikely that females would abandon their young due to their ability to carry pups from roost to roost during normal roost-switching behavior. The tendency for bats to switch roosts under normal circumstances would preclude this from causing negative effects to reproduction. If a maternity roost is discovered, an LOP from April 1 through August 1 would be applied within 300 feet surrounding the site. LOPs in place for spotted owls, goshawks and great gray owls would afford protection to bats roosting in these areas during pup rearing in the spring and summer months. Foraging behavior would not be affected due to their nocturnal foraging behavior.

Habitat Modification

Reforestation would result in a slight reduction of roost sites available for pallid bats and fringed myotis. However, many snags including most hardwood snags would be retained across the treatment units and would continue to provide roosting sites. Suitable habitat outside and adjacent to treatment units would continue to provide potential roosting sites interspersed with foraging habitat in the short and long-term. Prescribed fire would likely benefit these bats, resulting in some tree mortality and snag recruitment in the short-term.

Indicators

The following indicators were chosen to provide a relative measure of the direct and indirect effects to pallid, fringed myotis, and Townsend's big-eared bats and to determine how well project alternatives comply with Forest Plan Direction. These criteria were chosen based on the best available scientific literature which focuses on various aspects of pallid, fringed myotis and Townsend's big-eared bat ecology and life history requirements. These criteria focus on those life history aspects, or habitat elements, considered most limiting to these species' persistence across their range and where project effects are expected.

1. Acres of snag retention (pallid bats and fringed myotis).
2. Toxicological effects from herbicide use (pallid bats, Townsend's big-eared bats and fringed myotis).

Effects Common to Alternatives 1, 3 and 5

Direct and Indirect Effects

Because there is no difference in treatment units between these alternatives, the effects are expected to be the same for Indicator 1 and are therefore analyzed together.

Indicator 1

Trees or snags with existing cavities or furrowed bark provide roosting habitat for pallid bats and fringed myotis (Pierson 1996; Pierson et al. 2006). Suitable habitat occurs within and adjacent to treatment units. Hazard trees removed in green forest adjacent to reforestation areas is expected to be rare, but may result in a slight reduction of snags or roost sites available. Conifer snags would be retained at a rate of 12 to 30 square feet basal area or 4 to 6 per acre within treatment units. The largest size class available would be selected as the highest priority for retention and averaged across each unit, ensuring a supply of snags are retained throughout a given unit and the analysis area. Additionally, most hardwood snags would be retained, further contributing to important roosting habitat used by pallid bats. The hardwood and conifer snags across the project area would continue to provide short-term roost sites for pallid bats and fringed myotis. Trees that are declining across the project area will provide the long-term snag recruitment, generally outside of treatment areas. Forest edges and open habitats would remain intact and would continue to provide suitable foraging conditions for pallid bats, Townsend's big-eared bats and fringed myotis. Alternatives 1, 3 and 5 would have negligible effects on roost site availability, foraging habitat and foraging success for these species. About 30,354 acres of forested habitat within the analysis area are on NFS and available for bats within this landscape.

Indicator 2

Herbicide use under Alternatives 1 and 5 are expected to have some potential for direct or indirect toxicological effects on bats, as described under the herbicide risk assessment section. Because no herbicides are proposed under Alternative 3, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to bats would occur under this alternative.

Cumulative Effects

Appendix B identifies the present and reasonably foreseeable future actions on all lands within the analysis area. Some, but not all of these actions have or may contribute cumulatively to effects on Townsend's big-eared, pallid bats and fringed myotis.

Based on risk factors affecting these species, the following relevant evaluation criteria were used as relative measures of cumulative effects from Alternatives 1, 3 and 5: habitat modification and Disturbance. In addition, Alternatives 1 and 5 used toxicological effects for evaluation criteria.

Habitat Modification

Federal Lands

Present and foreseeable future projects on federal lands include: Funky Stewardship, Groovy Stewardship, Reynolds Creek Stewardship, Soldier Creek Timber Sale, Campy Timber Sale, Looney Timber Sale, Thommy Timber Sale, which are green thinning projects treating 6,100 acres of forest. All snags and many declining trees will be retained unless they pose a safety hazard in these projects. This snag and declining tree retention will provide snags in the short-term as well as recruit snags in the long-term. Other federal activities potentially impacting habitat for bats is the fuels reduction associated with the Rim Recovery project. Fuels reduction associated with this project will reduce the risk of further loss of remaining green forest within the project area.

Disturbance

Federal Lands

Several sources of noise disturbance occur throughout the forest and include activities such as timber harvest, mastication, prescribed fire operations, restoration and recreation. These activities have occurred in the past and present and will continue into the future (Twomile, Reynolds and Rim Fire Rehabilitation) whether or not this project is implemented. Mechanized equipment such as feller-bunchers, skidders and chippers are used to accomplish vegetation treatments, while more people would be used during prescribed fire operations for lighters, holders and fire engines. Under normal winter weather years, access to a large portion of the project area is restricted until late spring or early summer. The past two winters, have had almost no restrictions on access in virtually the entire Rim Fire area. Vegetation and prescribed fire treatments could occur during the pup rearing period, potentially affecting maternity colonies. Recreation disturbance likely occurs as soon as access to an area is opened and continues to some degree until access to the area is restricted by snow in the fall or early winter. Recreation disturbance would consist of OHVs, camping, hiking, cycling, wood cutting and passenger car driving. These effects vary in intensity, duration and scope with weekends typically being a higher use time than weekdays.

Private Lands

Noise disturbance on private lands will primarily consist of new plantation management, which could involve heavy equipment and personnel.

Toxicological Effects

Federal Lands

There is one present federal action of herbicide use on 0.5 acres under the Rim Fire Rehabilitation project and two foreseeable federal actions of herbicide use: 8.0 acres under the Twomile Ecological Restoration Noxious Weed project and 23 acres under a special use permit for the Reliable Power Project powerline. No other present or foreseeable future federal actions are related to herbicide use.

Private Lands

Herbicide use is proposed on 1,583 acres of private land within the project area in 2017. No other present or foreseeable future actions are proposed on private lands related to herbicide application.

Alternatives 1, 3 and 5 Contribution and Summary

Alternatives 1, 3 and 5 are expected to negligibly contribute cumulatively to effects on pallid and fringed myotis. Occasional removal of hazard trees as a result of implementation would result in slightly fewer roost sites. Disturbance at roost sites is possible and may result in displacement of individuals or groups of roosting bats, including roost abandonment. LOPs in place near day roosts would afford protection to roosting bats, as their pup rearing season overlaps with the breeding seasons for spotted owls, goshawks and great gray owls. Alternatives 1 and 5 would contribute to the short-term limited potential of exposure to toxicity from herbicide use. The cumulative contribution to effects on these species is considered negligible and is not expected to affect their viability.

Alternative 2

Direct and Indirect Effects

Under No Action, death, injury and disturbance would not be an issue because no active management would occur.

Indicator 1

The indirect effects of no action would result in retention of the maximum number of snags or potential roost sites across the project area. It is unknown how many additional roost sites would be retained under this alternative and what benefits would be realized by bats in the project area as a result of the availability of these additional roost sites.

Indicator 2

Because no herbicides are proposed under this alternative, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to bats would occur.

Cumulative Effects

The cumulative effects discussion under Alternative 1 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 2 Contribution and Summary

Under Alternative 2, no direct cumulative effect is expected because no active management would occur and it is unknown what indirect cumulative effects would be realized by bats on the 1,886 acres where some additional roost sites would be retained. Because no herbicides are proposed under this alternative, no exposure to herbicides and therefore no cumulative toxicological effects would occur.

Alternative 4

Direct and Indirect Effects

Indicator 1

There is essentially no overlap (10 acres) between suitable bat habitat and planting areas under this alternative. No measureable direct or indirect effects to roost site availability or foraging habitat are expected for indicator 1 under this alternative.

Indicator 2

Herbicide use under Alternative 4 is expected to have some potential for direct or indirect toxicological effects on bats, as described under the herbicide risk assessment section.

Cumulative Effects

The cumulative effects discussion under Alternatives 1, 3 and 5 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 4 Contribution and Summary

No cumulative effects to suitable habitat are expected from Alternative 4. Disturbance at roost sites is possible and may result in displacement of individuals or groups of roosting bats, including roost abandonment. LOPs in place near day roosts would afford protection to roosting bats, as their pup rearing season overlaps with the breeding seasons for spotted owls, goshawks and great gray owls. Alternative 4 would contribute to the short-term limited potential of exposure to toxicity from herbicide use. The cumulative contribution to effects on these species is considered negligible and is not expected to affect their viability.

Fringed Myotis, Pallid and Townsend's Big-Eared Bat: Summary of Effects

Indicator 1

Of the action alternatives, Alternative 4 would result in the highest level of snag retention. Alternative 4 may provide the greatest benefit to pallid bats and fringed myotis amongst the action alternatives; however, it is unknown if this assumed benefit would be realized.

Indicator 2

Herbicide use under Alternatives 1, 4 and 5 are expected to have limited potential for direct or indirect toxicological effects on bats. Because Alternative 4 has fewer acres of herbicide application proposed, the potential for effects would be less than under Alternatives 1 and 5. However, it is important to note that the toxicity exposure scenarios analyzed in the risk assessment show that all but one HQ value is less than the NOAEL threshold. The one scenario with an HQ of 1.0 just reaches the threshold of concern, meaning there is a slightly elevated toxicological risk for bats ingesting contaminated insects. Given the foraging behavior of these species, it is unlikely that they would realize this actual level of exposure. Therefore, these species are provided an adequate margin of safety in the event that they are exposed to contaminated prey or water.

Determinations

Alternatives 1 and 5

Alternatives 1 and 5 may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the pallid bat, Townsend's big-eared bat, or the fringed myotis. This determination is based on the following rationale:

- Snag retention would result in maintaining roosting structures throughout the treated areas.
- Foraging habitat would be available throughout the analysis area.
- Toxicity exposure levels from herbicide use under these alternatives are at or below the Forest Service established threshold of concern.

Alternative 2

Alternative 2 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the pallid bat, Townsend's big-eared bat or the fringed myotis. This determination is based on the following rationale:

- There would be no removal of snags throughout the analysis area.
- There would be no potential for exposure to herbicides.

Alternative 3

Alternative 3 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the pallid bat, Townsend's big-eared bat or the fringed myotis. This determination is based on the following rationale:

- Snag retention would result in maintaining roosting structures throughout the treated areas.
- Foraging habitat would be available throughout the analysis area.
- There would be no potential for exposure to herbicides.

Alternative 4

Alternative 4 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the pallid bat, Townsend's big-eared bat or the fringed myotis. This determination is based on the following rationale:

- There would be virtually no removal of snags throughout the analysis area.
- Foraging habitat would be available throughout the analysis area.

- Toxicity exposure levels from herbicide use under this alternative are at or below the Forest Service established threshold of concern.

Western Bumble Bee: Affected Environment

Species and Habitat Accounts

The Western Bumble Bee (*Bombus occidentalis*) is a Region 5 Forest Service Sensitive species. The western bumble bee currently occurs on many national forests throughout California and in all states adjacent to California. Historically, the western bumble bee was one of the most broadly distributed bumble bee species in North America (Cameron et al. 2011). Currently, the western bumble bee is experiencing severe declines in distribution and abundance due to a variety of factors including diseases and loss of genetic diversity (Tommasi et al. 2004; Cameron et al. 2011; Koch et al. 2012).

The overall status of populations in the west is largely dependent on geographic region: populations west of the Cascade and Sierra Nevada mountains are experiencing dire circumstances with steeply declining numbers, while those to the east of this dividing line are more secure with relatively unchanged population sizes. The reasons for these differences are not known.

No records of western bumble bee exist on the Stanislaus. The nearest documented western bumble bee was at Lake Eleanor in 1983, about one mile from the project area boundary (Thorp et al. 1983). No surveys for western bumble bee have been conducted on the Stanislaus to date.

The project area is not known to be within the current distribution of the western bumble bee in the Sierra Nevada Bioregion. Although their presence within the analysis area is undocumented, their presence is assumed where suitable habitat exists. Habitat considered suitable in this document includes montane chaparral, mixed chaparral, annual and perennial grassland, and wet meadows. There is about 69,000 acres of suitable habitat on the Stanislaus and about 95,400 acres on NFS lands and YNP lands. Several botanical species that are known to be utilized by the western bumble bee are found throughout the project area.

The following account of bumble bee life history is summarized from Heinrich (1979). Queens overwinter in the ground in abandoned rodent (i.e., mouse, chipmunk or vole) nests at depths from 6-18 inches and typically emerge about mid-March. The queen then lays fertilized eggs and nurtures a new generation. She first creates a thimble-sized and shaped wax honey pot, which she provisions with nectar-moistened pollen for 8 to 10 individual first-generation workers when they hatch. The larvae receive all of the proteins, fats, vitamins and minerals necessary for growth and normal development from pollen. Eventually all the larvae spin a silk cocoon and pupate in the honey pot. The workers that emerge begin foraging and provisioning new honey pots as they are created to accommodate additional recruits to the colony. Individuals emerging from fertilized eggs become workers that reach peak abundance during July and August. Foraging individuals are largely absent by the end of September. Those that emerge from unfertilized eggs become males, which do not forage and only serve the function of reproducing with newly emerged queens. During the season, a range of 50 to hundreds of individuals may be produced depending on the quantity and quality of flowers available. When the colony no longer produces workers, the old queen eventually dies and newly emerged queens mate with males and then disperse to found new colonies. During this extended flight that may last for up to two weeks she may make several stops to examine the ground for a suitable burrow. Mikkola (1984) reported that bumble bees may forage up to a distance of 80 km in Finland.

Unlike all other bees, bumble bees are large enough to be capable of thermoregulation, which allow them to maintain their foraging activities for longer periods of the day, but also to occupy regions with more extreme latitudes and temperatures compared to other bees (Heinrich 1979). Bumble bees may continue to forage when temperatures are below freezing even in inclement weather (Heinrich (1979).

Queens end the year by locating a sheltering burrow, where they may spend the winter months under cover. Where nesting habitat is scarce, bumble bee species having queens that emerge early (mid-March) in the season, like *B. vosnesenskii* which co-occurs with the later emerging *B. occidentalis*, may be able to monopolize available nest sites and reduce the chances of success for bumble bee species emerging later.

Bumble bees are central place foragers, meaning individuals rely on exploration to find resources (Osborne et al. 2008). Bees may communicate with chemical cues to fellow nest mates signaling the presence of a good food source (Dornhaus and Chittka 2001 and Dornhaus and Chittka 2004). The western bumble bee is a generalist forager, meaning they do not rely on any one flower or flower type. However, they have a short proboscis or tongue length relative to other co-occurring bumble bee species, which restricts nectar gathering to flowers with short corolla lengths and limits the variety of flower species it is able to exploit.

RISK FACTORS

1. *Non-native bumble bee species introductions*: Bumble bees introduced from Europe for commercial pollination apparently carried a microsporidian parasite, *Nosema bombi*, which has been introduced into native bumble bee populations. Highest incidences of declining *B. occidentalis* populations are associated with highest infection rates with the *Nosema* parasite, and the incidence of *Nosema* infection is significantly higher in the vicinity of greenhouses that use imported bumble bees for pollination of commercial crops (Cameron et al. 2011).
2. *Grazing*: According to studies done in England (Goulson et al. 2008), grazing during the autumn and winter months may provide excellent bumble bee habitat and prevent the accumulation of coarse grasses. Heavy grazing and high forage utilization should be avoided since flowering plants providing necessary nectar and pollen may become unavailable, particularly during the spring and summer when queens, workers and males are all present and active.
3. *Habitat fragmentation and alteration*: Bumble bees are threatened by many kinds of habitat alterations that may fragment or reduce the availability of flowers that produce the nectar and pollen they require, and decrease the number of abandoned rodent burrows that provide nest and hibernation sites for queens. In the absence of fire, native conifers encroach upon meadow habitat, which also decreases foraging and nesting habitat available for bumble bees.
4. *Development*: Major threats that alter landscapes and habitat required by bumble bees include agricultural and urban development. Exposure to organophosphate, carbamate, pyrethroid and particularly neonicotinoid insecticides has recently been identified as a major contributor to the decline of many pollinating bees, including honey bees and bumble bees (Henry et al. 2012; Hopwood et al. 2012; Krupke et al. 2012).

Western Bumble Bee: Environmental Consequences

The project action alternatives could result in direct and indirect effects to the western bumble bees through the following activities:

- Mechanical site preparation for planting.
- Herbicide application for site preparation and release.
- Biomass removal and similar fuel treatments.
- Planting conifers.

These direct and indirect effects include:

- Project related death, injury and disturbance.
- Project related modifications to habitat quantity or quality.

Death, Injury and Disturbance

Death or injury from project related activities could occur because this species nests and over winters underground in abandoned rodent burrows.

Project activities, such as heavy equipment use for site preparation, are expected to occur in thinning and reforestation units, project roads, and at landings. Ground disturbance from reforestation activities is likely to result in mortality and loss of any bee colony or overwintering queens in the area (Hatfield et al. 2012). Prescribed burning is also expected to occur in units and landings and could result in injury or death of overwintering queens if the nest is not deep enough to withstand the residual heat at the soil surface. Because no occurrence records on the forest or in the project area, the potential risk for death or injury is unknown.

Habitat Modification

Reforestation, thinning, and prescribed fire activities are expected to alter, fragment, and reduce bee habitat availability across the project area in the short-term (about 10-12 years). Reforestation and prescribed fire would reduce or remove forage through direct mortality of floral resources. Management activities should aim at improving diverse assemblages of primarily native flora and keeping undisturbed areas, such as logs, clumps of grass, and floral resources constantly available throughout the year so bees can find nesting, foraging, and overwintering sites (Blake et al. 2011). Assuring continuity of nectar and pollen resources when bees are active from spring to late summer is also recommended to mitigate project effects to bees (Schweitzer et al. 2012). Snag and downed log retention throughout the project area combined with oak buffers, small pockets of understory vegetation in planting units, and untreated areas, would provide short-term native plant cover and nesting or overwintering habitat for bees during project implementation. Thinning existing plantations is expected to result in a more open understory and recruitment of herbaceous vegetation which could benefit the bee following treatment (USDA/USDI 2015). Prescribed fire treatments do not typically result in 100% consumption of vegetation. Prescriptions call for a mosaic burn in which some vegetation is left intact. Therefore, herbaceous and woody vegetation would remain available to some extent in treated areas for bees.

Indicators

The following indicator was chosen to provide a relative measure of the direct and indirect effects to the western bumble bees and to determine how well project alternatives comply with Best Management Practices for Federal lands.

1. Habitat modification.
2. Toxicological effects from herbicide use.

These criteria were chosen based on the best available scientific literature which focuses on various aspects of western bumble bee ecology and life history requirements. These criteria focus on those life history aspects, or habitat elements, considered most limiting to western bumble bee persistence across suitable habitat and where project effects are expected.

Alternatives 1, 3 and 5

Direct and Indirect Effects

Because there is very little difference in the site preparation, prescriptions, and plantation release results, the effects are expected to be similar under these three alternatives and are analyzed together. The differences in herbicides proposed between Alternatives 1 and 5 versus Alternative 3 were separated below accordingly.

Indicator 1

Reforestation and Natural Regeneration

Under these alternatives about 26,000 acres of suitable habitat is proposed for reforestation. Ultimately this would result in up to a 38% reduction in the amount of suitable habitat across the project area. Site preparation is designed to eliminate competing vegetation from the planting areas, although this does not occur on every acre. This would be accomplished through deep tilling or herbicide application or a combination of both. The effects are the same: reduced habitat available for bees during implementation and management for the short-term (10-12 years). Implementation would be phased over several years and each unit includes areas where site preparation, herbicide application, and planting treatments would not occur. It is in these areas that suitable habitat would be retained.

Several management requirements would result in the retention of bee habitat in any given unit and across the entire project area. Sensitive and Watchlist plant sites would have buffers applied and would not be reforested, offering foraging opportunities for bees. In reforestation units, up to five oaks would be buffered and no reforestation or release treatments would occur within 20 feet of these oaks. This would provide up to 15% of any given acre that would contain habitat for bees. Up to 20% vegetative cover is also retained on each acre in reforestation units before release treatments are triggered. This would provide up to an additional 20% of a given acre that would contain habitat for bees. When combined, up to 35% of any given acre proposed for treatment could contain native floral resources available to bees. Areas where snags and downed logs are retained would also provide potential nesting or overwintering sites. While it is not known how much of these untreated areas would contain flowering plants utilized by bees, it is assumed that at least some portion would be suitable for foraging. Bumble bees have been documented to fly up to 0.9 miles from their nest site to foraging habitat (Osborne et al. 2008). Osborne and others (2008) found that the energetic cost of travelling from 0.08 miles to 0.9 miles to a foraging site did not appear to be prohibitive compared to the rewards gained (i.e., nectar and pollen). Cresswell and others (2000) used realistic parameters for time and energy expenditure to predict if foraging resources were inadequate that bumble bees could forage profitably at distances greater than 2.5 miles. Given the design criteria and potential for foraging habitat retention throughout the project area, it is unlikely that individuals would need to travel these distances to find foraging habitat.

Prescribed fire would be introduced to new plantations within 10 years of planting. USDA/USDI (2015) recommends implementing prescribed burning operations in the late fall to early spring and early or late in the day to mitigate some negative effects to bees. They also suggest leaving small unburned patches within burned areas to ensure that some flowers are always available. Prescribed burns are most often implemented fall through spring when the weather conditions are conducive with the burning prescription. This timeframe would ensure that the blooming period for many plants is avoided. While some habitat would be removed in the short-term, burning prescriptions include the objective of retaining patches of vegetation (i.e., suitable habitat) across the treatment area. Retaining open stand conditions using prescribed fire would also result in the long-term benefit of retaining suitable bee habitat.

Forested habitat was not identified as suitable habitat when calculating acres for this analysis; however, open canopied forests contain understory vegetation that would benefit bees (USDA/USDI 2015). About 10,800 acres are proposed for planting with the open canopy mosaic prescription and are located throughout the landscape. Therefore 12,200 acres out of the 26,000 proposed for reforestation are still expected to provide landscape level habitat benefits to bees (Ibid).

Thinning

Under these alternatives about 5,400 acres of existing plantation is proposed for thinning and creating an open canopy mosaic. Thinning existing plantations would result in opening up the understory promoting the recruitment of herbaceous vegetation within a year or two post treatment which would benefit bees in these areas (Schweitzer et al. 2012; USDA/USDI 2015). Prescribed fire would be the first tool used for thinning these stands. The goal in using prescribed fire is to open up these stands, creating a habitat mosaic of more open conditions. If we are unable to accomplish thinning by using prescribed fire, we would use mechanical means to achieve the desired conditions. The short-term impacts to forage availability and potential loss of nest or overwintering sites would be outweighed by the short- and long-term benefits realized by implementing these alternatives. While these units are classified as forested habitat, the open canopy desired condition in these units is expected to provide landscape level habitat benefits to bees (USDA/USDI 2015).

Indicator 2

Herbicide use under Alternatives 1 and 5 are expected to have some potential for direct or indirect toxicological effects on bees, as described under the herbicide risk assessment section. Because no herbicides are proposed under Alternative 3, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to bees would occur under this alternative.

CUMULATIVE EFFECTS

Appendix B identifies the present and reasonably foreseeable future actions on all lands within the analysis area. Some, but not all of these actions have or may contribute cumulatively to effects on western bumble bees.

Based on risk factors affecting bees, the following relevant evaluation criteria were used as relative measures of cumulative effects from Alternatives 1, 3 and 5: habitat modification. In addition, Alternatives 1 and 5 used toxicological effects for evaluation criteria.

Habitat Modification

Federal Lands

Present and foreseeable future activities on federal lands include meadow restoration (Reynolds Creek, Rim Habitat, Rim Rehabilitation, and Twomile meadow restoration). Other federal activities potentially impacting habitat for bees is grazing.

Meadow restoration projects are expected to improve foraging habitat across about 180 acres for bees. By removing encroaching conifers and improving hydrologic function of meadows on this landscape, native flora and habitat suitability in these meadows would increase forage availability for bees.

Grazing is occurring and will continue to occur across the analysis area whether or not this project is implemented. Grazing and high forage utilization should be avoided since flowering plants providing necessary nectar and pollen may become unavailable, particularly during the spring and summer when queens, workers and males are all present and active. Grazing is subject to utilization standards in the SNFPA (USDA 2004) that protect resources such as meadow habitat.

Private Lands

About 1,583 acres of herbicide application are on private lands in the foreseeable future across the analysis area. The near complete coverage of most acres across private lands has resulted in almost complete removal of foraging habitat for bees. These areas will likely not provide foraging habitat for bees for several years.

Toxicological Effects

Federal Lands

There is one present federal action of herbicide use on 0.5 acres under the Rim Fire Rehabilitation project and two foreseeable federal actions of herbicide use: 8.0 acres under the Twomile Ecological Restoration Noxious Weed project and 23 acres under a special use permit for the Reliable Power Project powerline. No other present or foreseeable future federal actions are related to herbicide use.

Private Lands

Herbicide use is proposed on 1,583 acres of private land within the project area in 2017. No other present or foreseeable future actions are proposed on private lands related to herbicide application.

Alternatives 1, 3 and 5 Contribution and Summary

Alternatives 1, 3 and 5 would contribute cumulatively to short- and long-term effects to western bumble bees. Reforestation would result in modification of about 38% of suitable habitat on NFS lands and about 27% of suitable habitat across the analysis area. Although suitable habitat would be altered, several design elements included in prescriptions under these alternatives would ensure habitat is available throughout the project area during implementation. Thinning of existing plantations would result in more open stand conditions increasing the amount of herbaceous and woody vegetation available as forage to bees across 6% of the analysis area. Using prescribed fire is expected to help create and maintain these conditions. These alternatives would result in the most suitable habitat modified when compared to Alternative 4. Alternatives 1 and 5 would contribute to the short-term potential of exposure to toxicity from herbicide use. Because no western bumble bees are documented on the Stanislaus, it is unknown to what degree the cumulative contribution under these alternatives may affect individual bees or the viability of this species.

Alternative 2

Under No Action, death, injury and disturbance would not be an issue because no active management would occur.

Indicator 1

The indirect effects of no action would likely benefit the western bumble bee. The early seral habitat present across the landscape would provide additional food, nesting, and overwintering resources to bees in the short-term. Over time, the shrubs will become dense thickets, eliminating essential forbs, an important food source for bees. This may affect long-term habitat suitability for bees across the landscape. When wildfire returns, it would reset the clock, beginning with the flood of herbaceous vegetation that is most valuable for bees.

Indicator 2

Because no herbicides are proposed under this alternative, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to bees would occur under this alternative.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 outline those present and foreseeable future activities scheduled on public and private lands.

Alternative 2 Contribution and Summary

Under Alternative 2, no direct cumulative effect is expected because no active management would occur; however, the indirect effects under this alternative would result in additional resource and habitat availability for bees in the short-term. Because no western bumble bees are documented on the Stanislaus, it is unknown to what degree the cumulative contribution under this alternative may affect individual bees or the viability of this species.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Indicator 1

Reforestation

Under Alternative 4, up to 2,950 acres of suitable habitat is proposed for reforestation. Up to 4,130 acres of suitable habitat would be subject to site preparation and release treatments (founder stands and the 50 foot buffer around each founder stand). This would result in up to a 6% decrease in the amount of suitable habitat across the project area on NFS lands. Site preparation is designed to eliminate competing vegetation from the planting areas. This would be accomplished through herbicide application. The effects are the same: reduced habitat available for bees during implementation and management for the short-term (10 to12 years). Implementation would be phased over several years and each unit includes areas where site preparation, herbicide application, and planting treatments would not occur. It is in these areas that suitable habitat would be retained.

Management requirements for reforestation described under Alternatives 1, 3 and 5 are also applicable under this alternative. In addition to the standard design criteria, no planting would occur within 200 feet of any sensitive plant site or within complex early seral habitat, both which provide habitat to bees.

Prescribed fire would be introduced to 50% of new plantations within 10 years and the other 50% between 10 and 20 years. The same burning prescriptions and expected retention of habitat discussed under Alternatives 1, 3 and 5 would apply under this alternative on a smaller scale.

Forested habitat was not identified as suitable habitat when calculating acres for this analysis; however, open canopied forests contain understory vegetation that would benefit bees (USDA/USDI 2015). Planting is proposed on 2,950 acres with an ultimate goal of being open canopy. Therefore the areas proposed for reforestation are still expected to provide some habitat benefits to bees (Ibid).

Thinning: Because prescriptions for thinning existing plantations under this alternative are the same as described under Alternatives 1, 3 and 5, the effects are expected to be the same, see discussion under Alternatives 1, 3 and 5.

Indicator 2

Herbicide use under Alternative 4 is expected to have some potential for direct or indirect toxicological effects on bees, as described under the herbicide risk assessment section.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 outline those present and foreseeable future activities scheduled on public and private lands.

Alternative 4 Contribution and Summary

Alternative 4 is expected to contribute cumulatively to effects on western bumble bees. Minor cumulative effects are expected from reforestation. Suitable habitat would be altered on up to 4% of the analysis area. Cumulative effects from thinning existing plantations are expected to be the same as described under Alternatives 1, 3 and 5. Alternative 4 would contribute to the short-term potential of exposure to toxicity from herbicide use. Because no western bumble bees are documented on the Stanislaus, it is unknown to what degree the cumulative contribution under this alternative may affect individual bees or the viability of this species.

Western Bumble Bee: Summary of Effects

Indicator 1

Table 3.16-16 shows, of the action alternatives, Alternative 4would result in the least amount of suitable habitat modification when compared to Alternatives 1, 3 and 5. Effects of thinning existing plantations would be the same among all action alternatives.

Table 3.16-16 Western Bumble Bee Summary of Effects: Habitat Modified

Indicator and Metric	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Acres of habitat modified[1]	26,000	0	26,000	4,130	26,000
Percent of habitat modified[1]	38	0	38	6	38

[1]NFS lands only

Indicator 2

Herbicide use under Alternatives 1, 4 and 5 are expected to have the potential for direct or indirect toxicological effects on bees. Because Alternative 4 has fewer acres of herbicide application proposed, the potential for effects would be less than under Alternatives 1 and 5. However, it is important to note that the toxicity exposure scenarios analyzed in the risk assessment show that all HQ values for clopyralid, aminopyralid, and clethodim are several orders of magnitude less than the NOEC threshold or No Observable Effect Concentration. The HQ values for the glyphosate scenarios of ingesting contaminated vegetation were slightly above the NOAEL threshold or No Observable Adverse Effect Level. The HQ values were 1.7 and 3.0, indicating an elevated toxicological risk for individual western bumble bees. Given the fact that most glyphosate spraying would occur before plants are flowering and no western bumble bees have been documented on the Stanislaus, it is unlikely that bees would realize this actual level of exposure. Therefore, this species is provided an adequate margin of safety in the event that they are exposed to direct spray or contaminated vegetation.

Determinations

ALTERNATIVES 1 AND 5

Alternatives 1and 5 may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the western bumble bee. This determination is based on the following rationale:

- Foraging, nesting, and overwintering habitat would be available throughout the analysis area in the short- and long-term.
- Most toxicity exposure levels from herbicide use under these alternatives are all several orders of magnitude below the Forest Service established threshold of concern.

ALTERNATIVE 2

Alternative 2 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the western bumble bee. This determination is based on the following rationale:

- There would be no modification of currently suitable habitat.
- There would be no potential for exposure to herbicides.

ALTERNATIVE 3

Alternative 3 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the western bumble bee. This determination is based on the following rationale:

- Foraging, nesting, and overwintering habitat would be available throughout the analysis area in the short- and long-term.
- There would be no potential for exposure to herbicides.

ALTERNATIVE 4

Alternative 4 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the western bumble bee. This determination is based on the following rationale:

- Foraging, nesting, and overwintering habitat would be available throughout the analysis area in the short- and long-term.

- Most toxicity exposure levels from herbicide use under these alternatives are all several orders of magnitude below the Forest Service established threshold of concern.

Black-Backed Woodpecker: Affected Environment

Species and Habitat Account

The black-backed woodpecker (*Picoides arcticus*) is not designated as a Region 5 Forest Service Sensitive species. They are currently listed as a Management Indicator Species (MIS) representing the ecosystem component of snags in burned forests, as described in the MIS Report.

Black-backed woodpeckers are distributed in boreal regions from south-central Alaska across Canada to Newfoundland and Nova Scotia, and south in the western United States in Montana and Washington through east-central California (Region 5 Sensitive species evaluation form for black-backed woodpecker 2012). The black-backed woodpecker is a monotypic species that occurs at elevations of 4,000 to 10,000 feet (1200 to 3000 meters) in the Siskiyou, Warner, and Shasta counties, the Sierra Nevada Mountains of California and Nevada south to the southern limits of Tulare County in Sequoia National Forest (Ibid).

Black-backed woodpeckers are still distributed across their historical breeding range in California (Bond et al. 2012). They have been documented within the Rim Fire perimeter in both 2014 and 2015, but in low numbers (White pers. comm.).

In December 2011, the California Fish and Game Commission accepted for consideration a petition submitted by the John Muir Project and the Center for Biological Diversity (Hanson and Cummings 2010) to list the black-backed woodpecker (*Picoides arcticus*) as Threatened or Endangered under the California Endangered Species Act. The Commission's December 15, 2011 action conferred on the species the interim designation of "candidate for listing", effective January 6, 2012, and gave the California Department of Fish and Game (now California Department of Fish and Wildlife or CDFW) 12 months from that date to review the petition, evaluate the available information, and report back to the Commission whether or not the petitioned action is warranted. In May 2013, the Fish and Game Commission found listing the black-backed woodpecker as Threatened or Endangered under CESA was not warranted (Bonham 2013).

The Commissions conclusion was based on the following summary (Bonham 2013):

- The lack of an apparent range retraction or changes in distribution within the range.
- The episodic cycles of high density occurrences (i.e., prey invasion, high woodpecker productivity, prey decline, and woodpecker dispersal) and the lack of current data on the cycle's impact on the long-term viability of California's black-backed woodpecker population.
- The lack of data concerning the role of green forest on the species but its apparent use as habitat.
- The trending increase in fire frequency, size, and severity as compared to the early and mid-20th century.
- Uncertainty regarding the magnitude of the threat posed to black-backed woodpeckers by post-fire salvage logging.
- Lack of logging on approximately 80% of severely burnt USFS forest habitat since 2003 (i.e., 87,200 acres).
- The ongoing long-term monitoring of the species as an MIS.
- Black-backed woodpecker populations in California are not geographically isolated from populations in adjacent states.

Having considered these factors, the Department concluded that the best available scientific information available to the Department does not indicate that the black-backed woodpecker's continued existence is in serious danger or is threatened by any one or any combination of the following factors found in relevant regulation: present or threatened modification or destruction of black-backed woodpecker habitat, overexploitation, predation, competition, disease, or other natural occurrences or human-related activities. (Cal. Code Regs., tit 14, § 670.1 (i)(1)(A)). Therefore, based upon the best scientific information available to the Department, listing the black-backed woodpecker as threatened or endangered is not warranted.

A consortium of environmental groups including the John Muir Project, the Center for Biological Diversity, the Blue Mountains Biodiversity Project, and the Biodiversity Conservation Alliance filed a petition (Hanson et al. 2012) to list the Oregon/California and Black Hills (South Dakota) populations of the black-backed woodpecker as Threatened or Endangered under the Federal Endangered Species Act. The U.S. Fish and Wildlife Service prepared a 90-day finding indicating that the petitioned action may be warranted based on the information provided by the petitioners; therefore when funds become available, they will initiate a review of the status of the two populations to determine if listing either or both the Oregon Cascades-California population and the Black Hills population as either subspecies or Distinct Population Segments is warranted (USFWS 2013a). Currently, the USFWS website says this species is under review.

The IUCN Red List of Threatened Species evaluated the black-backed woodpecker as a species of "Least Concern" in 2012 (http://www.iucnredlist.org/details/22681181/0). IUCN provided justification for this evaluation as follows: "This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20,000 km^2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend appears to be stable, and hence the species does not approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is extremely large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern".

NatureServe has ranked this species as G5 = demonstrably secure at the Global level and N4 = apparently secure at the National level (NatureServe.org). The state/province threat status indicates the California ranking is S3/S4 (vulnerable/apparently secure). The CDFW website was queried and indicates that as of January 2016 this species is ranked by the State as S2 (imperiled).

Population trends of black-backed woodpeckers are poorly known (Bond et al. 2012). Such analyses are especially difficult for this species due to the ephemeral nature of the woodpecker's burned habitat, its tendency not to re-use nesting cavities in subsequent years, and the low density at which the species occurs in unburned forests (Ibid). Inclusion of black-backed woodpecker monitoring in the Forest Service's MIS program for 10 national forest units in California, as well as additional research, should yield trend information for the species in burned forests of the Sierra Nevada and southern Cascades in the coming years (Siegel et al. 2008, 2010, 2011, 2012, 2015; Saracco et al. 2011). According to Siegel et al. (2015), "there is no evidence for a trend in fire-level occupancy by black-backed woodpeckers, but there is marginal evidence of a negative linear trend in point-level occupancy, amounting to an annualized loss of 1.35% of points per year during the six years (2009-2014) we have been monitoring black-backed woodpeckers on National Forests in California. Although the distribution of the species appears to change slightly from year to year, black-backed woodpeckers remain present across their historic range in California" (p. 39).

Trend information available from Breeding Bird Surveys (BBS) is available; however, these trend estimates were based on observations along only five BBS routes. Trends in black-backed woodpecker populations according to BBS data throughout the species range were non-significantly positive between 1966 and 2007 but significantly negative (minus 7% per year) between 1980 and 2007. Within the Sierra Nevada Physiographic Province, including most of the species range in

Region 5, trends were non-significantly negative during both 1966 to 2006 and 1980to 2006. Thus, black-backed woodpecker trends are not well-monitored by the BBS methodology, due to its patchy distribution and low detection probability during passive point counts (Region 5 Sensitive species evaluation form for black-backed woodpecker 2012).

The number of black-backed woodpeckers occupying recent fire areas that burned from 2000 to 2010 in the Sierra Nevada appears not to exceed several hundred pairs (Bond et al. 2012). Population estimates in 'green' forests of the Sierra Nevada range from several hundred to several thousand pairs (Ibid).

The analysis area is within the current distribution of black-backed woodpeckers across the Sierra Nevada Bioregion. Prior to the Rim Fire, there were very few acres of burned forest suitable for black-backed woodpeckers within the Rim Recovery analysis area. Exact acres could not be calculated because snag retention from previous fires and the associated projects were based on numbers of snags, not acres of snag patches. However, only low snag densities were retained and many of those snags have likely fallen. Therefore it is reasonable to assume that there were very few acres, if any, of burned forest suitable for black-backed woodpeckers prior to the Rim Fire. The project contains suitable habitat for this species and presence has been documented in various locations throughout the fire area (White pers. comm., pers. obs.).

The black-backed woodpecker is strongly associated with burned forests, more closely than any other western bird species (Hutto1995; Hutto 2008; Bond et al. 2012). Although the black-backed woodpecker is found in unburned forested stands throughout its range, population densities in recently burned forest stands are substantially higher (Hutto 1995; Hoyt and Hannon 2002; Smucker et al. 2005; Hutto 2008; Fogg et al. 2012). During broadcast surveys for black-backed woodpeckers in burned forests throughout the Sierra Nevada, southern Cascades, and Warner mountains in 2009 and 2010, 95% of detections were between 4,793 – 8,517 feet (1,461 and 2,596 meters) above sea level (R. Siegel unpublished data). Survey stations above (9,186 feet (2,800 meters) have not been established, so the upper boundary of the range of detection may be higher than currently documented. Black-backed woodpecker home-ranges are highly variable and are shown to range from 59 to 751 acres (24 to 304 hectares) (Siegel pers. comm.; Siegel et al. 2013, 2014; Tingley et al. 2014b). Snag basal area alone best predicted home-range size, explaining 54 to 62% of observed variation (Tingley et al. 2014b). As snag basal area increased, home-ranges exponentially decreased in size, strongly suggesting increased habitat quality.

Suitable black-backed woodpecker habitat is defined specifically for this project and includes the following CWHR habitat types, size classes, and densities: Douglas-fir (DFR), Jeffrey pine (JPN), lodgepole pine (LPN), ponderosa pine (PPN), red fir (RFR), subalpine conifer (SCN), Sierran mixed conifer (SMC), and white fir (WFR); size classes greater than or equal to 3; pre-fire canopy closures M and D; and basal area mortality greater than or equal to 50%. Habitat criteria used in this analysis were determined from CWHR (CDFW 2008), scientific literature (e.g., Russell et al. 2007; Hanson and North 2008; Vierling et al. 2008; Bond et al. 2012; Siegel et al. 2013; Siegel et al. 2014); and USDA Forest Service Region 5 Regional Office guidance.

Burned forest habitat is most productive for black-backed woodpeckers during the first eight years following a fire. Burned habitat on private lands is assumed to be completely removed through salvage logging. Treatments are limited on National Park Service Lands, typically consisting of minimal removal of hazardous trees along roadways. NFS lands are treated to varying degrees following a fire, typically harvesting only a small proportion of fire-killed trees in burned forest.

Suitable habitat exists outside the Rim Fire perimeter within California on NFS lands and is distributed throughout the Sierra Nevada and California. For example, in 2012, the Chips and Reading Fires on the Lassen and Plumas National Forests burned about 75,000 acres of NFS lands, of which about 67,000 acres of burned NFS lands remain untreated. In 2013, the American and Aspen

Fires burned about 44,000 acres on NFS lands, of which about 32,000 acres of burned NFS lands will remain untreated. In 2014, the King Fire burned about 63,500 acres on NFS lands, of which about 10,000 acres will be salvaged or treated for fuels reduction. On the Stanislaus National Forest wildfires occurred in the past several years and include:

1. The Knight Fire in 2009 burned about 6,000 acres, of which zero acres were salvaged;
2. The Ramsey Fire in 2012 burned about 1,000 acres, of which 250 acres was salvaged;
3. The Power Fire in 2013 burned about 1,000 acres, of which zero acres were salvaged; and,
4. The Rim Fire in 2013 burned about 257,000 acres (155,000 on NFS Lands), of which 42,300 were either salvaged, treated for fuels reduction, or hazard tree removal.

As is evident with the acres burned versus the acres treated displayed above, most burned habitat remains on the landscape and provides habitat benefits to black-backed woodpeckers. When combined with suitable burned forest habitat on National Park Service such as Yosemite, even more habitat is available to black-backed woodpeckers. According to Miller and Safford (2012) and Westerling et al. (2006), large, high-severity wildfires have been increasing in frequency and duration over the past few decades and are predicted to continue into the future. Based on these reported trends and the large, high severity fires that have occurred in Region 5 over the past few years, it is reasonable to assume that the availability of burned forest habitat will continue increasing into the future.

The Rim Fire burned primarily on public land in two administrative units: Stanislaus National Forest and Yosemite National Park. Most of the suitable black-backed woodpecker habitat within the Rim Fire perimeter occurs on Yosemite National Park. Table 3.16-17 shows the amount of suitable habitat on public lands considered in the analysis of direct and indirect effects. Habitat that is currently being treated or scheduled for treatment in the near future (i.e., suitable habitat analyzed under Rim Recovery) is not included in table 3.16-17 or the direct and indirect effects analysis for this project. It is considered in the cumulative effects analysis for this project. Suitable habitat on private lands is assumed to have been removed through salvage operations.

Black-backed woodpeckers are primary cavity excavators, creating holes in trees in which to lay their eggs and raise their young (Dixon and Saab 2000). The breeding season generally occurs from April through July and both sexes incubate, brood, and feed young (Bond et al. 2012). Nest cavities are usually excavated in snags but can be found in dead portions of live trees and in unburned forests. Nests are excavated in conifer trees and typically average 13 to 14 inches, which corresponds to CWHR size classes 4 and 5. Nest trees have occasionally been documented as small as 7 inches, which corresponds with CWHR size class 3 (Bond et al. 2012; Seavy et al. 2012).

Table 3.16-17 Amount of Suitable Black-Backed Woodpecker Habitat in the Rim Fire Area

Ownership	Suitable Habitat (acres)	Proportion of Habitat (percent)
Stanislaus National Forest[1]	10,326	37%
Yosemite National Park	17,487	63%
Total	**27,813**	**100%**

[1] Acres reported here represent existing suitable habitat acres considered for direct and indirect effects analysis only.

Black-backed woodpeckers readily forage on larvae of wood-boring beetles, engraver beetles, and mountain pine beetles found in the trunks of burned conifers (Dixon and Saab 2000). Hanson and North (2008) found preferential foraging on large snags greater than 20 inches dbh (50 centimeters) in a study of 3 fire areas in the Sierra Nevada, which corresponds to CWHR size classes 4 to 6. Preliminary data from an ongoing study at two recent fire areas on Lassen National Forest suggests that black-backed woodpeckers forage on all available size classes of snags, but they forage on snags 4 inches less than was predicted (R. Siegel unpub. data).

Black-backed woodpeckers in western North America are not known to be migratory, although limited down-slope dispersal in winter has been reported (Dixon and Saab 2000). Reliance on recently burned areas of coniferous forest for breeding necessitates some post-breeding and post-natal dispersal to colonize new burns, but dynamics of dispersal in this species are not well studied (Ibid.). Occasional irruptions of hundreds of 100's of km or more have been documented in eastern North America in response to food- resource and breeding dynamics; similar irruptions in western North America have not been recorded. In the Sierra Nevada, black-backed woodpeckers frequently colonize burned forest patches and breed in them less than one year after fire; no information is available indicating how far such individuals have dispersed (Dixon and Saab 2000; Siegel et al. 2008).

RISK FACTORS

Risks factors to black-backed woodpeckers have been summarized in "A Conservation Strategy for the black-backed woodpecker (*Picoides arcticus*) in California – Version 1.0":

1. *Salvage logging and other management involving post-fire snag removal*: Management activities commonly employed following wildfire include salvage logging and hazard tree removal have resulted in negative impacts such as reduced abundance and reproductive success in black-backed woodpeckers (Saab and Dudley 1998; Hutto and Gallo 2006; Saab et al. 2007; Koivula and Schmiegelow 2007; Hutto 2008; Cahall and Hayes 2009). Saab and Dudley (1998) and Hutto and Gallo (2006) found that nest densities were much higher in unlogged post-fire stands when compared with salvaged stands.
2. *Thinning of unburned forests*: Pre-fire forest thinning can decrease post-fire occupancy rates and nest densities of black-backed woodpeckers, and thinning or removal of medium and large snags may decrease habitat suitability in unburned forests. For example, black-backed woodpecker abundance in forests that were commercially thinned and then later burned in wildfire was lower than in burned forests that were not thinned before fire in the Rocky Mountains (Hutto 2008).
3. *Firewood cutting for personal use in recent fire areas*: Although systematic data on the effects of fuelwood cutting on nesting black-backed woodpeckers are not available, small scale harvesting of fuelwood by the public for personal use, from recent fire areas as well as unburned lodgepole pine forests, can destroy active black-backed woodpecker nests.
4. *Time since fire*: Probability of occupancy and nesting by black-backed woodpeckers in burned forest is negatively correlated with years since fire during the decade after the fire.
5. *Fire Suppression*- If fire suppression reduces the amount of mid- and high-severity post-fire habitat available for black-backed woodpecker, it may be considered a threat to the species.
6. *Climate change*: Although uncertain, climate change may affect the black-backed woodpecker through altered fire regimes and adjustments in distribution (e.g., occupying higher elevations and northern latitudes.

Black-Backed Woodpecker: Environmental Consequences

This analysis is focused on the project effects related to management of burned forest, areas with documented basal area mortality greater than 50%. The project alternatives could result in direct and indirect effects to the black-backed woodpecker through the following activities:

- Removal of fire-killed trees.

These direct and indirect effects include:

- Project related death, injury and disturbance.
- Project related modifications to habitat quantity or quality.

Death, Injury and Disturbance

Death or injury from project related activities would be unlikely to occur given the mobility of this species. However, there is the potential for death or injury if a nest tree were felled while being used by black-backed woodpeckers. These potential direct effects are considered to be short-term and will only affect treated areas. Retained snags in treated areas would continue to provide cavity and foraging substrates. Untreated areas that burned at high severity and are suitable black-backed woodpecker habitat would be left intact, providing nesting and foraging habitat for black-backed woodpeckers.

Project activities, especially loud noise, could result in disturbance that may impair essential behavior patterns of the black-backed woodpeckers related to breeding or foraging. Loud noise from equipment such as chainsaws or tractors is expected to occur in reforestation units, on project roads, and at landings. The location of black-backed woodpeckers within the analysis area is uncertain but expected given the increase in available suitable habitat following the Rim Fire. Temporary avoidance of the project site or displacement of individuals is expected during project implementation.

Any displacement or avoidance related to noise disturbance would be of short duration and would subside shortly after project implementation activities. LOPs in place for spotted owls, goshawks, great gray owls, and bald eagles would afford protection to individual black-backed woodpeckers in these areas during the breeding season. The potential risk to individual black-backed woodpeckers is uncertain because the presence of suitable habitat is a recent development and limited surveys have been conducted. They have been documented in the project area in both 2014 and 2015 in low numbers.

The length of exposure to these disturbances is considered short-term and would occur in different areas any given year as implementation progresses across the landscape.

Habitat Modification

Removal of fire-killed trees in reforestation units would degrade suitable black-backed woodpecker habitat by removing burned snags this species requires for breeding and foraging. Home ranges are known to average about 89 hectares or 220 acres based on recent research (Tingley et al. 2014b). The basal area of burned snags is correlated with the home range size of black-backed woodpeckers (Ibid). Retaining large patches of burned snags, preferably greater than 220 acres and at elevations above 4,793 feet would provide high quality habitat for black-backed woodpeckers, potentially increasing the predicted bird density across the analysis area (Bond et al. 2012; Tingley et al. 2014b). Although treated areas are not expected to provide suitable habitat that would contribute to a black-backed woodpecker home range, snags retained within treated areas could provide foraging and possibly nesting structures. In addition, trees that survived the fire will remain on the landscape. Some of these trees will likely die, contributing to snag recruitment over the next several years and will provide additional habitat for black-backed woodpeckers.

In order to compare alternatives and potential effects to black-backed woodpeckers, we used a model developed by Tingley and others (2014a) that was designed specifically for the Rim Fire area. This model presents a method for predicting black-backed woodpecker pair density that combines model-based estimates of occupancy with expected bird density given occupancy (Ibid). Some of the covariates used in the model include pre-fire canopy cover, burn severity, CWHR size class 3 and greater, and CWHR forest class. This model allows us to compare alternatives, accounting for the expected effects to black-backed woodpeckers. The model predicts the probability that a single cell (100 by 100 feet) is occupied by a black- backed woodpecker. The developer's intent for use of this model includes using density estimates to examine the relative effects of proposed alternatives to black-backed woodpeckers. Values are relative and should scale proportionally (Ibid).

Incorporating removal of habitat from the Rim HT and Rim Recovery projects, a total of 21 predicted pairs of black-backed woodpeckers are within the Rim Fire area on the Stanislaus. For analysis of direct and indirect effects associated with this project, 21 were used as the maximum predicted pair density possible.

Indicators

The following indicators were chosen to provide a relative measure of the direct and indirect effects to the black-backed woodpecker and to determine how consistent the project alternatives are with this species' conservation strategy recommendations.

1. Amount of suitable habitat modified.
2. Predicted pair density retained as a proportion of modeled pairs (Tingley et al. 2014a).
3. Toxicological effects from herbicide use.

These criteria were chosen to supplement the information provided in the MIS report by identifying and analyzing potential effects to the black-backed woodpecker related to expected densities within the project area. While the Rim Recovery MIS Report focuses on the relationship of project-level habitat impacts to bioregional scale and trend, the effects analysis here focuses on the relative value of different proposed management units by alternative within the Rim Fire area based on habitat quantity and quality (Tingley et al. 2014a). Acres in this analysis may vary slightly from those presented in the MIS report due to rounding error or to minor corrections made to continuously revised dynamic database sources.

Alternatives 1, 3 and 5

Because there is no difference in the areas proposed for treatment under these three alternatives, the effects are expected to be same and are analyzed together. The differences in herbicides proposed between Alternatives 1 and 5 versus Alternative 3 were separated below accordingly.

DIRECT AND INDIRECT EFFECTS

Indicator 1

Under Alternatives 1, 3 and 5, about 2,260 acres of suitable habitat would be modified, while 8,066 acres of suitable habitat would be retained (Table 3.16-18). Snags would be retained at a rate of 12 to 30 square feet of basal area per acre, averaged on a unit basis. While snags retained at this density are not expected to provide suitable habitat that would contribute to a black-backed woodpecker home range, they would provide foraging and possibly nesting structures.

Indicator 2

Under Alternatives 1, 3 and 5 about 76% of modeled pairs (16) would be retained on NFS lands (Table 3.16-18). Of the action alternatives, Alternatives 1, 3 and 5 result in the least amount of habitat retention for black-backed woodpeckers and the lowest predicted pair density.

Indicator 3

Herbicide use under Alternatives 1 and 5 are expected to have limited potential for direct or indirect toxicological effects on black-backed woodpeckers, as described under the herbicide risk assessment section. Because no herbicides are proposed under Alternative 3, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to black-backed woodpeckers would occur under this alternative.

CUMULATIVE EFFECTS

Appendix B identifies the present and reasonably foreseeable future actions on all lands within the analysis area. Some, but not all of these actions have or may contribute cumulatively to effects on black-backed woodpeckers.

Based on risk factors affecting black-backed woodpeckers, the following relevant evaluation criteria were used as relative measures of cumulative effects of Alternatives 1, 3 and 5 to black-backed woodpeckers: habitat modification. In addition, Alternatives 1 and 5 used toxicological effects for evaluation criteria.

Habitat Modification

Federal Lands

Present and foreseeable future fuels reduction projects on federal lands include: Funky Stewardship, Groovy Stewardship, Reynolds Creek Stewardship, Soldier Creek Timber Sale, Campy Timber Sale, Looney Timber Sale, Thommy Timber Sale, which are green thinning projects treating 6,100 acres of green forest. All snags and many declining trees will be retained unless they pose a safety hazard in these projects. This snag and declining tree retention will provide snags in the short-term as well as recruit snags in the long-term.

The Rim Recovery project (salvage and fuels reduction) is also a present action. About 11,000 acres of suitable black-backed woodpecker habitat are either currently being treated or will be treated in the near future. This habitat is modeled to support about 12 pairs of black-backed woodpeckers.

Toxicological Effects

Federal Lands

There is one present federal action of herbicide use on 0.5 acres under the Rim Rehabilitation project and two foreseeable federal actions of herbicide use: 8.0 acres under the Twomile Noxious Weed project and 23 acres under a special use permit for the Reliable Power Project powerline. No other present or foreseeable future federal actions are related to herbicide use.

Private Lands

Herbicide use is proposed on 1,583 acres of private land within the project area in 2017. No other present or foreseeable future actions are proposed on private lands related to herbicide application.

Alternatives1, 3 and 5 Contribution and Summary

Alternatives 1, 3 and 5 are expected to contribute cumulatively to effects on black-backed woodpeckers. The cumulative contribution from this project under Alternatives 1, 3 and 5 would reduce the suitable habitat by an additional 2,260 acres and reduce the number of modeled black-backed woodpecker pairs by an additional 5 pairs. When combined with the Rim Recovery project, a total of 13,260 acres of suitable habitat would be removed and a reduction of 17 modeled pairs of black-backed woodpeckers would occur (Table 3.16-19). The predicted pair density within the remaining suitable habitat on the Stanislaus National Forest and Yosemite National Park is 80 pairs (82%) of black-backed woodpeckers in the Rim Fire perimeter. Alternatives 1 and 5 would contribute to the short-term potential of exposure to toxicity from herbicide use. The cumulative contribution to effects on black-backed woodpeckers is considered minor and is not expected to affect the species viability.

Alternative 2

Under No Action, death, injury and disturbance would not be an issue because no active management would occur.

DIRECT AND INDIRECT EFFECTS

Indicators 1 and 2

The indirect effects of No Action are related to the amount of habitat retained and predicted pair density across the project area. Under this alternative, 10,326 acres of suitable habitat would be available to black-backed woodpeckers (Table 3.16-18). The predicted pair density associated with this alternative is 21 (Table 3.16-18). This alternative provides the greatest amount of habitat and the highest predicted pair density when compared to Alternatives 1, 3 and 5. It provides the same amount of suitable habitat and predicted pair density as Alternative 4. Black-backed woodpeckers would be expected to occupy the available suitable habitat for the next 6 to 8 years, which is typically the period of time burned habitat is most suitable for this species.

Indicator 3

Because no herbicides are proposed under this alternative, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to black-backed woodpeckers would occur under this alternative.

CUMULATIVE EFFECTS

Under the No Action alternative, no direct cumulative effect is expected because no active management would occur.

Alternative 2 Contribution and Summary

The cumulative contribution under this alternative would result in the highest retention of suitable habitat available for black-backed woodpeckers when compared to Alternatives 1, 3 and 5 (Table 3.16-19). Alternative 4 results in the same retention as the No Action alternative because no suitable black-backed woodpecker habitat is proposed for planting under Alternative 4. Retention of about 10,326 acres (30%) of suitable habitat on NFS lands is expected from implementation of this alternative. The predicted pair density within the analysis area is 21 pairs of black-backed woodpeckers. About 27,813 acres of suitable black-backed woodpecker habitat would be retained across the analysis area on NFS lands and Yosemite National Park. This habitat is predicted to support a total of 85 pairs of black-backed woodpeckers.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Indicators 1 and 2

Because no treatments are proposed in suitable black-backed woodpecker habitat under this alternative, effects are expected to be the same as discussed under Alternative 2.

Indicator 3

Herbicide use under Alternative 4 is expected to have limited potential for direct or indirect toxicological effects on black-backed woodpeckers, as described under the herbicide risk assessment section.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternatives 1, 3 and 5 outline those present and foreseeable future activities scheduled on public and private lands.

Alternative 4 Contribution and Summary

Cumulative effects related to habitat modification under this alternative are expected to be the same as discussed under Alternative 2. Alternative 4 would contribute to the short-term potential of exposure to toxicity from herbicide use. The cumulative contribution to effects on black-backed woodpeckers is considered minor and is not expected to affect the species viability.

Black-backed Woodpecker: Summary of Effects

Indicator 1

The amount of suitable habitat modified varies among the action alternatives, shown in Table 3.16-18. Alternatives 1, 3 and 5 would result in the greatest amount of suitable habitat modified when compared to Alternative 4. Alternative 4 would result in the least amount of suitable habitat modified.

Table 3.16-18 Blacked-Backed Woodpecker Summary of Direct and Indirect Effects

Indicator and Metric	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
1. Amount of suitable habitat modified on NFS lands[1]	2,260	0	2,260	0	2,260
1. Percent of suitable habitat modified[1]	22	0	22	0	22
2. Predicted pair density retained (modeled pairs retained)	16	21	16	21	16
2. Predicted pair density retained (% of modeled pairs retained)	76	100	76	100	76

[1] Based on acres of suitable habitat on Stanislaus National Forest as defined in the affected environment section above.

Indicator 2

Table 3.16-18 shows the predicted pair density varies between action Alternatives 1, 3 and 5 and Alternative 4. Alternatives 1, 3 and 5 would result in the lowest predicted pair density when compared to Alternative 4. Alternative 4 would result in the highest predicted pair density among the action alternatives.

Table 3.16-19 Blacked-Backed Woodpecker Summary of Cumulative Effects

Indicator	Proposed and Present Projects	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
1. Amount of suitable habitat modified	Suitable habitat modified on Stanislaus-Rim Reforestation (acres)	2,260	0	2,260	0	2,260
	Suitable habitat modified on Stanislaus-Rim Recovery[1] (acres)	11,000	11,000	11,000	11,000	11,000
	Total suitable habitat modified within Rim Fire Perimeter (acres)	13,260	11,000	13,260	11,000	13,260
	Total suitable habitat modified within Rim Fire perimeter (percent)	35	29	35	29	35
2. Predicted pair density retained as a proportion of modeled pairs	Modeled pairs retained	80	85	80	85	80
	Percent modeled pairs retained	82	88	82	88	82

[1] Rim Recovery calculations represent the amount of acres that have not been treated as of March 2016.

Indicator 3

Herbicide use under Alternatives 1, 4 and 5 are expected to have limited potential for direct or indirect toxicological effects on black-backed woodpeckers. Because Alternative 4 has fewer acres of herbicide application proposed, the potential for effects would be less than under Alternatives 1 and 5. However, it is important to note that the toxicity exposure scenarios analyzed in the risk assessment show that all but three HQ values are at or less than the NOAEL threshold or No Observable Adverse Effect Level. Three scenarios with HQs from 1.1 to 1.8 involve ingestion of contaminated insects or fruit. These HQs are just above the threshold of concern, meaning there is a slightly elevated toxicological risk for individual black-backed woodpeckers ingesting contaminated insects or fruit. Given the foraging behavior of these species, it is unlikely that they would realize this actual level of exposure. Therefore, this species is provided an adequate margin of safety in the event that individuals are exposed to contaminated prey, fruit, or water.

Black-backed Woodpecker: Consistency with Conservation Strategy

No standards and guidelines or direction specific to black-backed woodpecker are in the Stanislaus National Forest, Forest Plan Direction (USDA 2010a). The Conservation Strategy for the Black-backed Woodpecker (*Picoides arcticus*) in California version 1.0 includes the following recommendations:

- Recommendation 1.1. Within the range of the Black-backed Woodpecker, ensure that post-fire management occurring in new fires that burn 123 acres (50 hectares) or more of conifer forest at moderate- to high-severity consider snag retention and other burned-forest habitat needs of the species.
- Where feasible, Black-backed Woodpeckers will likely benefit most from large patches of burned forest being retained in unharvested condition.
- Recommendation 1.4. Retain high tree density in the unburned forest periphery around fire areas, to provide foraging habitat in the later post-fire years (see Saab et al. 2011).
- Recommendation 1.5. Avoid harvesting fire-killed forest stands during the nesting season (generally May 1 through July 31).

The action alternatives do not specifically incorporate a limited operating period for this species to prohibit salvage harvest during the black-backed woodpecker nesting season. However, the action alternatives do incorporate limited operating periods for Sensitive species within potential black-backed woodpecker habitat. Additionally, 78 to 100% of existing suitable habitat would be retained under all action alternatives. Alternative 4 considers full snag retention and no harvest within suitable black-backed woodpecker habitat.

It is important to note, the Conservation Strategy for Black-backed Woodpecker (*Picoides arcticus*) in California (Bond et al. 2012) is not a legally binding or regulatory document or agency policy; moreover, it was not designed to constrain the FS in its actions and activities. It seeks to summarize known information about the species, recommends management approaches for conservation, and suggests future research priorities (Bond et al. 2012). By its very nature, the Black-backed Woodpecker Conservation Strategy only considers one species. The FS has to balance multiple priorities, objectives, uses, and species in its activities as a multiple use agency. And, at times, certain management objectives are in tension, if not direct conflict, with one another. For example, through this Project, the Forest Service seeks to plant conifers to reestablish green forest for species dependent upon it; yet, the Forest Service also wishes to conserve burned forest habitat for the black backed woodpecker and other species. The Forest Service has tried to strike a reasonable balance between these two goals at the landscape level, realizing it is not possible to fully achieve both of these goals on each and every acre.

Mule Deer: Affected Environment

Species and Habitat Account

The mule deer (*Odocoileus hemionus*) is an MIS species representing oak-associated hardwood and hardwood/conifer in the Sierra Nevada. The mule deer is also a species of conservation concern on the Stanislaus and is considered common to abundant with a wide distribution throughout the Sierra Nevada. They occur at elevations of 1,800 to 11,800 feet on the west slope of the Sierra Nevada.

Summer range typically occurs above 6,500 feet elevation, transition range occurs between 4,500 to 6,500 feet elevation and winter range from 1,800 to 4,500 feet elevation. Mule deer are an important game species that is hunted throughout its range in California.

Trends in the migratory deer populations on the Stanislaus have been declining since the 1970s (Maddox 1980). The Tuolumne and Yosemite herds have experienced downward population trends over the past several decades (Graveline pers. comm.).

Deer composition counts are conducted by CDFW in the spring and fall of each year in order to assess population trends. In 2009, Greg Gerstenberg, Senior Environmental Scientist with CDFW, initiated a study of the Tuolumne Mule Deer Herd to investigate exotic louse infestation, effects on individuals, potential spread, and the resulting influence on deer populations. Ear tag radio transmitters and G.P.S. collars are being used to monitor deer and gather data on over-winter survival, habitat relationships such as migration routes, summer range extent, and winter range habitat use (Gerstenberg 2012, unpub. report).

Collared deer were monitored shortly after the Rim Fire burned through the critical winter range for the Tuolumne Deer herd. Several collared individuals were lost, which indicates loss of many deer during the fire (Gerstenberg pers. comm.). Because the fire hit prior to the winter migration, most migratory deer were still on their summer ranges at higher elevations. There is a resident herd that remains in the lower country year round and these deer were much more susceptible to mortality from the Rim Fire. About 80% of collared deer (n=5) are thought to have perished in the fire (Graveline pers. comm.).

The Tuolumne and Yosemite deer herds have summer, transition, and winter range within the analysis area. The Jawbone Ridge area on the Stanislaus currently supports the highest concentration of wintering California mule deer from the Tuolumne Deer Herd and much of this area burned at high severity in the Rim Fire.

Mule deer utilize a variety of vegetation types including oak woodlands, coniferous forest, meadows and grasslands, chaparral and riparian corridors. Favorable habitat conditions for deer include vegetation communities that occur in a mosaic pattern with multiple age classes represented, and where cover and forage are in close proximity to free water (Ahlborn 2006).

Mule deer are polygynous; bucks mate with multiple does. Rutting begins in the fall and dominant bucks mate with multiple does as they come into estrous. Bucks fight and displace each other establishing and reestablishing dominance throughout the season. Gestation is about six to seven months, with fawns born typically May through July on the Stanislaus.

Mule deer browse or graze, showing preferences for forbs and grasses, as well as tender new shoots on various shrub species including mazanita, ceanothus, mountain mahogany, and bitterbrush (Kufeld 1973). Forage patterns vary with season, forage quality, and availability. Acorns are a critically important fall and winter food. Fawns from the Tuolumne Herd have an average weight that is 10 to15% greater with a heavy black oak acorn crop (Gerstenberg, unpub. data).

Mule deer are either resident or migratory. Migratory deer travel downslope in the winter where conditions are milder and snow pack is minimal. The deer migrate upslope in the spring and early summer after the snow melts to birth fawns and gain access to high elevation meadows and grasslands that offer herbaceous forage high in nutrients.

RISK FACTORS

Risks to mule deer on the Stanislaus have been summarized by CDFW (Maddox 1980) and include:

1. *Range decadence*: Areas where shrub communities become decadent from the lack of fire or active management results in forage providing lower quality nutrients to deer. Areas become inaccessible or unavailable and may impact individual fitness.
2. *Grazing*: On the summer range, cattle and deer compete for limited forage found in meadows and grasslands. Conflicts between cattle and deer on the winter range are not known to be a limiting factor for deer on the Stanislaus.
3. *Oak and shrub removal in type conversions*: Establishment of plantations in areas that would otherwise be dominated by shrub and oaks can reduce the amount of forage available to deer in a given area.

4. *Poaching*: Poaching occurs most often on the winter range and has affected not only the number of deer, but the age distribution of bucks. Poachers typically target older bucks presumably for the extensive antlers sought by many hunters; however, does are taken as well.
5. *Loss of Acorn Producing Oaks due to Catastrophic or Stand Replacing Wildfire*: Oaks take several decades to develop the capacity to produce acorns. Oaks that are lost to wildfire effectively reduce the amount of forage available and this is a critical food source in both transition and winter ranges.
6. *Loss of Meadow Habitat*: Meadows are an important component of deer habitat. Conifer encroachment threatens the viability and availability of meadows in the long-term.

Mule Deer: Environmental Consequences

The project alternatives could result in direct and indirect effects to the mule deer through the following activities:

- Mechanical site preparation for planting.
- Herbicide application for site preparation and release of conifers.
- Planting conifers.
- Prescribed fire

These direct and indirect effects include:

- Project related death, injury and disturbance.
- Project related modifications to habitat quantity or quality.

Death, Injury and Disturbance

Death or injury from project related activities would be unlikely to occur given the mobility of this species. Project activities, especially loud noise, could result in disturbance that may impair essential behavior patterns of deer primarily on the winter range and transition or intermediate zones present within the analysis area. Loud noise from equipment such as chainsaws or tractors is expected to occur in reforestation and thinning units. Temporary avoidance of the project site or displacement of individuals is expected during project implementation. Any displacement or avoidance would be of short duration and would subside shortly after project implementation activities. The potential risk to individual deer is considered low because of their natural avoidance behavior.

Habitat Modification

Thinning green plantations would result in short- and long-term benefits to mule deer. Short-term, thinning existing plantations would allow us to release surviving oaks and create effective hiding and thermal cover adjacent to foraging habitat. Thinning would also open up areas for herbaceous vegetation to reclaim the understory. Under these conditions, early seral vegetation, shrubs, grasses, and forbs are expected to establish within a few years post treatment. Creating a more open canopy forest would improve the ability of deer to evade predators. Additionally, thinning these areas would increase structural diversity and resiliency when fire moves through this area in the future.

Limited reforestation in deer winter range would also result in short- and long-term benefits to deer. Short-term, reforestation of areas adjacent to high quality forage would increase accessibility to foraging habitat and provide protection from inclement weather throughout the winter range. Optimizing the location and size of hiding and thermal cover patches interspersed with foraging habitat would increase habitat effectiveness on the winter range (Thomas 1979). Long-term, foraging habitat interspersed with mature forest cover would provide high quality winter range and improve individual and herd health and survival. Using prescribed fire would also result in short- and long-term benefits including reducing dense thickets of shrubs that grow up next to oaks making them more vulnerable to mortality from wildfire, providing new more palatable forage in a variety of age classes, and maintaining open conditions in the understory to provide for easy navigation of the landscape. While Salwasser and others (1982) have suggested that optimal habitat structure for deer in areas of cover includes dense vegetation, the vegetation under four feet should be sufficiently open to allow for deer movement. More open conditions would also improve the ability for deer to more easily evade predators.

Indicators

The following indicators were chosen to provide a relative measure of the direct and indirect effects to mule deer.

1. Acres of hiding and thermal cover adjacent to high quality foraging areas and travel corridors, thinned and planted.
2. Toxicological effects from herbicide use.

These criteria were chosen based on the best available scientific literature, which focuses on various aspects of deer ecology and life history requirements. These criteria focus on those life history aspects, or habitat elements, considered most limiting to deer persistence across their range and where project effects are expected.

Alternative 1, 3 and 5

DIRECT AND INDIRECT EFFECTS

Because there is very little difference in the planting prescription and outcome in the short- and long-term under these three alternatives, the effects of indicator 1 are expected to be similar under these three alternatives and are analyzed together.

Indicator 1

Reforestation and Natural Regeneration

Under Alternatives 1, 3 and 5, about 646 acres are proposed for reforestation to provide forested cover in areas that burned at high severity in the Rim Fire in 2013. These areas, if reforested, would maximize habitat capability across the winter range. Benefits of these treatments include improving concealment cover and thermal relief along important movement corridors between foraging and bedding areas and increasing access to high quality foraging habitat. Reforestation would result in habitat improvement and increased access to forage across the winter range.

The planting prescriptions under Alternatives 1 and 3 for hiding cover include alternating clusters of three and five trees and providing a 30 foot oak buffer for up to five oaks per acre. The desired condition is to create an open canopy structure that provides effective hiding cover, concealment from predators and humans. Planting prescriptions for thermal cover include planting individual trees ranging from 10 to 14 foot spacing while also providing buffers for up to five oaks per acre as described for hiding cover. All other oaks under both prescriptions would become part of the planting prescription, taking the place of a conifer seedling when planting.

The planting prescription under Alternative 5 is the same across all 646 acres: planting conifers with a 7 by 14 foot spacing. Up to five oaks per acre would be buffered as described under Alternatives 1 and 3. With the tighter spacing of planted trees, it would be necessary to thin the plantations around year 7 to create the open canopy desired for hiding cover and to provide longer-term growing space to individual trees in areas designated for thermal cover. While the initial planting prescription calls for more trees, the outcome and long-term benefits described under Alternatives 1 and 3 above, would be realized under Alternative 5 with the incorporation of thinning these new plantations around year 7. Thinning would be by hand and material would be piled and burned on site. This is not expected to affect deer as this would be limited in scope and duration. Prescribed fire would be introduced to all new plantations as early as ten years after planting. Benefits of prescribed fire are discussed under habitat modification.

Thinning

Under these alternatives, 1,164 acres were identified for thinning within existing plantations. With the dense vegetation conditions that currently exist in these plantations, deer have limited movement corridors within the winter range and are more susceptible to predation (Gerstenberg pers. comm.). These conditions have resulted in much less deer use in these plantations today than several years ago (pers. obs.). Trees range from 8 to 12 inches dbh and are mature enough to provide the designated cover type immediately post treatment.

Deer are expected to benefit in the short- and long-term from the thinning of existing plantations. Prescribed fire would be the first tool used for thinning these stands. The goal in using prescribed fire is to open up stands, creating a habitat mosaic of more open conditions interspersed with dense pockets of trees that together would serve as hiding and thermal cover. If we are unable to accomplish thinning by using prescribed fire, we would use mechanical means to achieve the desired conditions. Surviving oaks greater than or equal to 6 inches dbh would be targeted for release, removing any conifer within 30 feet of the bole of up to 5 oaks per acre. All other oaks would be included in the matrix of the stand where the remaining conifers would either be thinned to create hiding or thermal cover. Hiding cover areas would be thinned to create several small groups of trees (four to seven per group) with 30-foot spacing between groups. Thermal cover areas would be thinned to a spacing of about 20 to 25 feet to promote denser forested conditions.

Under these alternatives, thinning the plantations would result in more open stand conditions much easier for deer to navigate. Thinning would also increase light penetration and the availability of herbaceous forage throughout these stands. Proposed treatments would result in beneficial impacts on individual fitness through increased forage availability and quality, as well as the potential reduction in susceptibility to predation across the critical winter range.

The combination of thinning existing plantations and reforesting areas adjacent to high quality foraging habitat would improve habitat conditions across about 70% of the critical winter range. The collective suite of treatments including reforestation and thinning adjacent to high quality foraging habitats, and prescribed fire to manage vegetation densities and decadence, would result in high quality and sustainable habitat throughout the 7,000-acre critical winter range.

Indicator 2

Herbicide use under Alternatives 1 and 5 are expected to have limited potential for direct or indirect toxicological effects on mule deer, as described under the herbicide risk assessment section. Because no herbicides are proposed under Alternative 3, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to mule deer would occur under this alternative.

Noxious Weeds

Herbicides would be used to eradicate noxious weeds. The long-term benefits of noxious weed treatments near Jawbone Lava Flat include increased forage availability on critical winter range.

CUMULATIVE EFFECTS

Appendix B identifies the present and reasonably foreseeable future actions on all lands within the analysis area. Some, but not all of these actions have or may contribute cumulatively to effects on mule deer.

Based on risk factors affecting deer, the following relevant evaluation criteria were used as relative measures of cumulative effects from Alternatives 1, 3 and 5: habitat modification. In addition, Alternatives 1 and 5 used toxicological effects for evaluation criteria.

Habitat Modification

Federal Lands

Present and foreseeable future activities on federal lands include: Funky Stewardship, Groovy Stewardship, Reynolds Creek Stewardship, Soldier Creek Timber Sale, Campy Timber Sale, Looney Timber Sale, Thommy Timber Sale, which are green thinning projects treating 6,100 acres of green forest across the analysis area. Releasing oaks is a part of all thinning prescriptions, which will protect an important food source for deer across the landscape, including transition zones. Fuels reduction associated with the Rim Recovery project will reduce the risk of further loss of remaining green forest within the project area. Other federal activities potentially impacting habitat for mule deer is meadow restoration.

Meadow restoration projects (Reynolds Creek, Rim Rehabilitation, Twomile Meadow Restoration) are expected to improve foraging habitat across about 180 acres for mule deer. By removing encroaching conifers and improving hydrologic function of meadows on this landscape, habitat suitability in these meadows would increase forage availability for deer.

Toxicological Effects

Federal Lands

There is one present federal action of herbicide use on 0.5 acres under the Rim Rehabilitation project and two foreseeable federal actions of herbicide use: 8.0 acres under the Twomile Noxious Weed project and 23 acres under a special use permit for the Reliable Power Project powerline. No other present or foreseeable future federal actions are related to herbicide use.

Private Lands

Herbicide use is proposed on 1,583 acres of private land within the project area in 2017. No other present or foreseeable future actions are proposed on private lands related to herbicide application.

Alternatives 1, 3 and 5 Contribution and Summary

Alternatives 1, 3 and 5 would contribute cumulatively to short- and long-term beneficial effects to mule deer by providing hiding and thermal cover in close proximity to high quality foraging habitat as well as releasing surviving and resprouting oaks, a critical food source for deer on their winter range. With a combination of thinning and reforestation where appropriate, habitat conditions would be improved throughout the 7,000 acres of designated critical winter range. Prescribed fire would play an important role in maintaining high quality habitat conditions across the winter range. These alternatives would result in benefits not realized under Alternative 4 where only 88 acres is proposed for reforestation, leaving high quality foraging habitat inaccessible. Alternatives 1 and 5 would contribute to the short-term potential of exposure to toxicity from herbicide use. Benefits for deer from the effective eradication of noxious weeds such as medusahead include increased herbaceous forage availability in critical wintering areas including Jawbone Lava Flat and far outweigh the limited exposure risk presented from the use of herbicides. The cumulative contribution under these alternatives may affect individual mule deer, but is not expected to affect the viability of this species.

Alternative 2

DIRECT AND INDIRECT EFFECTS

Under No Action, death, injury and disturbance would not be an issue because no active management would occur.

Indicator 1

The indirect effects of no action are primarily related to the influence no action may have on the availability of cover adjacent to high quality foraging habitat and important travel corridors, and not maintaining desired cover densities and palatable forage using prescribed fire. Under this alternative, it is likely that shrub cover would take the place of potential forested habitat. In the short-term, this would provide some cover and relief for deer from weather and predators. In the long-term, the shrubs would grow into dense thickets, prohibiting deer movement, increasing susceptibility to predation, and increasing range decadence. No thinning of existing plantations would occur under this alternative. Surviving and resprouting oaks would not be released from competition and fuel loading would continue to increase adjacent to oaks resulting in increased vulnerability to mortality when the next wildfire moves through the winter range.

Indicator 2

Because no herbicides are proposed under this alternative, no exposure to herbicides and no direct, indirect, or cumulative toxicological effects to mule deer would occur under this alternative.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternative 1 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 2 Contribution and Summary

Under Alternative 2, no direct cumulative effect is expected because no active management would occur; however, there may be indirect consequences under this alternative primarily related to the influence no action may have on the availability of cover adjacent to high quality foraging habitat and important travel corridors and not maintaining desired cover densities and palatable forage using prescribed fire. Oaks in untreated plantations would be at risk of loss when fire returns to this landscape. At the landscape scale, the cumulative contribution under this alternative would not increase habitat effectiveness for mule deer. The cumulative contribution under this alternative may negatively affect individual and potentially herd fitness, but would not likely affect the viability of the species across its range in the Sierra Nevada Bioregion.

Alternative 4

DIRECT AND INDIRECT EFFECTS

Indicator 1

Reforestation

Under Alternative 4, only 88 acres are proposed for reforestation. This is 558 acres less planting than proposed under Alternatives 1, 3 and 5. The planting prescription under this alternative is termed founder stands. This prescription calls for small variable shaped planting areas ranging from two to ten acres in size within a larger unplanted area. The planted area is only 20% of a given unit. Plant 20 to 40 clusters per acre spaced an average of 33 feet apart. Within each cluster, plant five trees spaced six feet between each tree. Herbicides would be used to control shrubs and competing vegetation within planted areas and incorporating a 25 to 50 foot buffer around planted areas. With the tighter spacing of planted trees, it may be necessary to thin the plantations around year 7 to allow growing space for the trees to mature. Mechanical thinning is not proposed under this alternative; however, prescribed fire is proposed and would be used to thin the new plantations. Prescribed fire would be applied to 50% of planted areas within ten years and the other 50% within 20 years. Prescribed fire is expected to result in benefits similar to those discussed under the habitat modification section. Reforestation effects under this alternative include reduced access to high quality foraging habitat and reduced thermal cover and reduced habitat effectiveness. This alternative is less beneficial to deer when compared to Alternatives 1, 3 and 5.

Thinning

Under Alternative 4, the thinning prescriptions and expected effects are the same as described under Alternatives 1, 3 and 5.

Indicator 2

Herbicide use under Alternative 4 is expected to have limited potential for direct or indirect toxicological effects on mule deer, as described under the herbicide risk assessment.

Noxious Weeds

Herbicides would not be used to eradicate noxious weeds, but we would use other methods such as prescribed fire and targeted grazing to reduce weed populations where feasible. The long-term benefits of noxious weed treatments near Jawbone Lava Flat could be realized if prescribed fire and grazing are successful. Benefits include increased forage availability on critical winter range.

CUMULATIVE EFFECTS

The cumulative effects discussion under Alternative 1 outlines those present and foreseeable future activities scheduled on public and private lands.

Alternative 4 Contribution and Summary

Alternative 4 would contribute cumulatively to short- and long-term effects to mule deer. This alternative would provide only 13% of the desired hiding and thermal cover in close proximity to high quality foraging habitat. This alternative would result in reduced habitat effectiveness across the winter range when compared to Alternatives 1, 3 and 5. Thinning existing plantations would result in improved habitat conditions across about 2,600 acres. Prescribed fire would play an important role in maintaining habitat conditions across the winter range, including reducing fuel loading and stimulating growth of new palatable forage. Alternative 4 would contribute to the short-term potential of exposure to toxicity from herbicide use. The cumulative contribution under these alternatives may affect individual mule deer, but is not expected to affect the viability of this species.

Mule Deer: Summary of Effects

Indicator 1

Table 3.16-20 shows, of the action alternatives, Alternatives 1, 3 and 5 would improve the greatest amount of habitat by thinning existing plantations, planting conifers in close proximity to high quality foraging habitat, and using prescribed fire to maintain high quality habitat conditions. Alternative 4 would improve the least amount of habitat and would incorporate the use of prescribed fire to maintain habitat conditions.

Table 3.16-20 Mule Deer Summary of Effects

Indicator and Metric	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
1. Hiding and thermal cover adjacent to high quality foraging areas (acres reforested[1])	646	0	646	88	646
1. Hiding and thermal cover adjacent to high quality foraging areas (acres of existing plantation thinned)	1,164	0	1,164	1,164	1,164

[1] Includes natural regeneration

Indicator 2

Herbicide use under Alternatives 1, 4 and 5 are expected to have limited potential for direct or indirect toxicological effects on mule deer. Because Alternative 4 has fewer acres of herbicide application proposed, the potential for effects would be less than under Alternatives 1 and 5. However, it is important to note that the toxicity exposure scenarios analyzed in the risk assessment show that all HQ values are less than the NOAEL threshold of concern or No Observable Adverse Effect Level. Therefore, this species is provided an adequate margin of safety in the event that individuals are exposed to contaminated vegetation or water.

3.17 Short-Term Uses and Long-Term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

Short-term uses are those that occur within the first few years of project implementation. Long-term productivity refers to the capability of the land and resources to continue producing goods and services long after the project is complete. No short-term uses of a renewable resource are a part of this project. Trees can be reestablished and grow if the long-term productivity of the land is maintained. Long-term productivity is maintained through application of management requirements described in Chapter 2, in particular those applicable to soil and water resources.

The action alternatives (1, 3, 4 and 5) all would provide for the long-term productivity of the project area through site preparation, planting, release, and noxious weed treatments creating a resilient forest where areas can recover from future fire effects naturally.

3.18 Unavoidable Adverse Effects

Implementation of any action alternative would result in some unavoidable adverse environmental effects. Although formation of the alternatives included avoidance of some effects, other adverse effects could occur that cannot be completely mitigated. The environmental consequences section for each resource area discusses these effects (Chapter 3).

3.19 Irreversible and Irretrievable Commitments

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of a mined ore. No irreversible commitments of resources would result from implementation of any action alternative because no permanent, irreversible resource loss would occur.

Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line right-of-way or road. Irretrievable losses can be regained over time. Implementation of any action alternative would not irretrievably commit resources, but help in the long-term recovery of the landscape.

3.20 Other Required Disclosures

The Rim Reforestation project was prepared in accordance with the following laws and regulations.

National Environmental Policy Act

The National Environmental Policy Act of 1969 (NEPA) requires that all major federal actions significantly affecting the human environment be analyzed to determine the magnitude and intensity of those impacts and that the results be shared with the public and the public given opportunity to comment. The regulations implementing NEPA further require that to the fullest extent possible, agencies shall prepare EISs concurrently with and integrated with environmental analyses and related surveys and studies required by the Endangered Species Act of 1973, the National Historic Preservation Act of 1966, and other environmental review laws and executive orders. Other laws and regulations that apply to this project are described below.

Clean Air Act

The Clean Air Act of 1970 provides for the protection and enhancement of the nation's air resources. No exceeding of the federal and state ambient air quality standards is expected to result from any of the alternatives. The Clean Air Act makes it the primary responsibility of States and local governments to prevent air pollution and control air pollution at its source.

California has a plan that provides for implementation, maintenance, and enforcement of the primary ambient air quality standards. This project is located in an area designated as non-attainment for Ozone. The burn treatments in the action alternatives will be conducted under an EPA approved California Smoke Management Program (SMP). Under the revised Conformity Rules the EPA has included a Presumption of Conformity for prescribed fires that are conducted in compliance with a SMP; therefore, the federal actions conform and no separate conformity determination is indicated (3.02 Air Quality).

Clean Water Act

The Clean Water Act of 1948 (as amended in 1972 and 1987) establishes federal policy for the control of point and non-point pollution, and assigns the states the primary responsibility for control of water pollution. The Clean Water Act regulates the dredging and filling of freshwater and coastal wetlands. Section 404 (33 USC 1344) prohibits the discharge of dredged or fill material into waters (including wetlands) of the United States without first obtaining a permit from the U.S. Army Corps of Engineers. Wetlands are regulated in accordance with federal Non-Tidal Wetlands Regulations (Sections 401 and 404). No dredging or filling is part of this project and no permits are required.

Compliance with the Clean Water Act by National Forests in California is achieved under state law. The California Water Code consists of a comprehensive body of law that incorporates all state laws related to water, including water rights, water developments, and water quality. The laws related to water quality (sections 13000 to 13485) apply to waters on the national forests and are directed at protecting the beneficial uses of water. Of particular relevance for the Rim Reforestation project is section 13369, which deals with non-point-source pollution and best management practices. As described in 3.15 Watershed, the action alternatives result in the maintenance of the applicable beneficial uses of water in the Water Quality Control Plan for the California Central Valley Water Quality Control Board.

Endangered Species Act

Section 7 (d) of the Endangered Species Act (ESA) of 1973 requires that after initiation of consultation required under section 7(a)(2), a Federal agency "shall not make any irreversible or irretrievable commitment of resources with respect to the agency action which has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative which would not violate subsection (a)(2)."

Rim Fire Recovery (2014)

The Rim Fire started on August 17, 2013. Several days later, it became clear the Rim Fire was a large incident, the forest initiated contact with the USFWS to alert them of potential impacts from the fire or fire suppression activities to listed species, including valley elderberry longhorn beetle and listed or candidate amphibian species. Forest service biologists conducted a field trip with a USFWS biologist in the Rim Fire burn area on November 4, 2013 to discuss conditions and concerns for listed species.

The Forest Service then prepared a Biological Assessment (BA) and a subsequent addendum following a meeting with USFWS, considering the effects to three federally listed species: California red-legged frog (Threatened), Sierra Nevada yellow-legged frog (Endangered), and valley elderberry longhorn beetle (Threatened) are found within the project analysis area in Tuolumne County, California (USDA 2014g). That BA requested concurrence with the determination that the overall project ‘may affect, not likely to adversely affect” the valley elderberry longhorn beetle, and “may affect, likely to adversely affect” California red-legged frog and Sierra Nevada yellow-legged frog. As such, the Forest Service engaged with the USFWS in formal consultation and requested a Biological Opinion (BO) in support of these determinations with the acknowledgement that effects to individuals or habitat are not discountable.

The determination of “may affect, likely to adversely affect” for California red-legged frog and Sierra Nevada yellow-legged frog was limited to 7 locales. Section 7(a)(2) of the ESA requires Federal agencies, in consultation with USFWS and the National Marine Fisheries Service (NMFS), to insure that their actions are “not likely to jeopardize the continued existence of any” listed species (or destroy or adversely modify its designated critical habitat; 16 USC 1536(a)(2)). As such, my decision is that no operational implementation activities will occur in those 7 locales as part of this decision until such time as formal consultation with USFWS results in issuance of a BO.

Rim Fire Reforestation (2015)

In February 2015, the Forest Service met with USFWS to discuss numerous projects within the Rim Fire foot print including reforestation. On August 19, 2015 the Stanislaus National Forest formally requested to begin conferencing on the Reforestation project with USFWS.

The Rim Reforestation project unit specific treatments (EIS Appendix E) reflect project management requirements and the content of the BA. The project does not lie within a critical habitat unit for the California red legged frog per the Federal Register (March 17, 2010; Volume 75, Number 51) and is not within a proposed critical habitat unit for the Sierra Nevada yellow legged frog per the Federal Register (April 25, 2013; Volume 78, Number 80).

Environmental Justice

Executive Order 12898 “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Population” requires that federal agencies make achieving environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health and environmental effects of their programs, policies, and activities on minority populations and low-income populations. As described in 3.10 Society, the action alternatives would not disproportionally impact minority or disadvantaged groups.

Floodplain Management

Executive Order 11988 applies to Floodplain Management. Floodplains are found along stream channels throughout the project area. Implementation of this decision would maintain or improve the existing condition of these floodplains by maintaining or improving meadow conditions. The intent of Executive Order 11988 would be met since this project would not affect floodplains in the Rim Reforestation analysis area and thereby would not increase flood hazard. As described in 3.15 Watershed, no measurable changes in stream flow are anticipated from the action alternatives.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act decreed that all migratory birds and their parts (including eggs, nests, and feathers) were fully protected. Under the Act, taking, killing or possessing migratory birds is unlawful. The original intent was to put an end to the commercial trade in birds and their feathers that wreaked havoc on the populations of many native bird species. On January 17, 2001 President

Clinton signed Executive Order 13186, directing executive departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act (FR Vol. 66, No.11, January 17, 2001).

The Forest Service and USFWS entered into a memorandum of understanding (MOU) to promote the conservation of migratory birds as a direct response to the executive order (USDA and USFWS 2008). One of the steps outlined for the Forest Service is applicable to this analysis: "Within the NEPA process, evaluate the effects of agency actions on migratory birds, focusing first on species of management concern along with their priority habitats and key risk factors." The Forest Service additionally agreed, to the extent practicable, to evaluate and balance benefits against adverse effects, to pursue opportunities to restore or enhance migratory bird habitat, and to consider approaches for minimizing take that is incidental to otherwise lawful activities.

This analysis complies with the Migratory Bird Treaty Act but may result in an "unintentional take" of individuals during proposed activities. However the project complies with the USFWS Director's Order #131 related to the applicability of the Migratory Bird Treaty Act to Federal agencies and requirements for permits for "take". In addition, this project complies with Executive Order 13186 because the analysis meets agency obligations as defined under the December 8, 2008 Memorandum of Understanding between the Forest Service and USFWS designed to complement Executive Order 13186 (Migratory and Landbird Conservation Report 2015). If new requirements or direction result from subsequent interagency memorandums of understanding pursuant to Executive Order 13186, this project would be reevaluated to ensure that it is consistent.

National Forest Management Act

The National Forest Management Act (NFMA) of 1976 amends the Forest and Rangeland Renewable Resources Planning Act of 1974 and sets forth the requirements for Land and Resource Management Plans for the National Forest System.

The Forest Service completed the Stanislaus National Forest Land and Resource Management Plan (Forest Plan) on October 28, 1991. The "Forest Plan Direction" (USDA 2010a) presents the current Forest Plan management direction, based on the original Forest Plan, as amended. The Forest Plan identifies land allocations and management areas within the project area including: Wild and Scenic Rivers, Proposed Wild and Scenic Rivers, Critical Aquatic Refuge (CAR), Riparian Conservation Areas (RCAs), Near Natural, Scenic Corridor, Special Interest Areas, Wildland Urban Intermix, Protected Activity Centers (PACs), Old Forest Emphasis Areas, and Developed Recreation Sites.

The Forest Plan and its amendments were prepared pursuant to the 1982 version of the NFMA planning regulations (36 CFR 219 (1983)). The current regulations, adopted in 2012 supersede those regulations, as well as other versions of the NFMA planning regulations (36 CFR 219.17(c) "This part supersedes any prior planning regulation."). The current NFMA planning regulations do not apply to this project (36 CFR 219.7(c) "None of the requirements of this part apply to projects or activities on units with plans developed or revised under a prior planning rule …"). Therefore, the sole NFMA duty applicable to this project is for the project to be consistent with the governing Forest Plan[8].

The Forest Plan Compliance document (project record) identifies the Forest Plan S&Gs applicable to this project and provides related information about compliance with the Forest Plan. Based on that document and other information in the project record, the action alternatives are consistent with the Forest Plan and all other requirements of the National Forest Management Act.

[8] The Forest Plan, although developed pursuant to the 1982 planning regulations, did not incorporate any specific aspects of those planning regulations. For example, the Forest Plan includes Management Indicator Species (MIS) and was designed to maintain the viability of wildlife species, as required by the former 36 C.F.R. § 219.19 regulations, the Forest Plan did not incorporate any of the particular legal requirements from the 1982 regulations related to MIS or viability. Therefore, the 1982 regulations are not directly applicable to this project.

National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966 is the principal, guiding statute for the management of cultural resources on NFS lands. Section 106 of NHPA requires federal agencies to consider the potential effects of a Preferred Alternative on historic, architectural, or archaeological resources that are eligible for inclusion on the National Register of Historic Places and to afford the President's Advisory Council on Historic Preservation an opportunity to comment. The criteria for National Register eligibility and procedures for implementing Section 106 of NHPA are outlined in the U.S. Code of Federal Regulations (36 CFR Parts 60 and 800, respectively). Section 110 requires federal agencies to identify, evaluate, inventory, and protect National Register of Historic Places resources on properties they control.

The Stanislaus National Forest developed a specialized agreement: "Programmatic Agreement Among United States Department of Agriculture, Forest Service, Stanislaus National Forest, the California State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Program of Rim Fire Emergency Recovery Undertakings, Tuolumne County, California" (Rim PA, project record). This agreement defines the Area of Potential Effects (APE) (36 CFR 800.4(a)(1)) and includes a strategy outlining the requirements for cultural resource inventory, evaluation of cultural resources, and effect determinations; it also includes protection and resource management measures that may be used where effects may occur. Additionally, this agreement provides opportunities to reforest and remove/eradicate noxious weeds within some sites after consultation with the local tribe.

Protection of Wetlands

Executive Order 11990 requires protection of wetlands. Wetlands within the project area include meadows, stream channels, springs, fens, and shorelines. The EIS (3.03 Aquatic Species; 3.15 Watershed) and the Watershed Report address wetlands and riparian vegetation. This project is consistent with Executive Order 11990 since this project would maintain or improve the condition of wetlands in the Rim Reforestation project area (3.15 Watershed).

4. Consultation and Coordination

This Chapter includes a section for Preparers and Contributors followed by a section for Distribution of the EIS.

4.01 Preparers and Contributors

The Forest Service worked with the following individuals; federal, state and local agencies; organizations; and, tribes during the development of this EIS.

Interdisciplinary Team

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Education: A.A. General Education, Chabot College 2000; B.S. Wildlife Management, Humboldt State University 2003
Experience: Wildlife Biologist, Stanislaus National Forest 8 years; Wildlife Biologist, Bureau of Land Management 2 years; Wildlife Technician, BLM 3 years
Team Responsibility: Wildlife

Maria Benech

Education: A.A. General Education, Modesto Junior College 1984; B.S. Natural Resources Management (Watershed), California Polytechnic State University San Luis Obispo 1987
Experience: ID Team Leader, Stanislaus National Forest 2 years; Resource Management Program Area Leader, Stanislaus National Forest 15 years; Forester, Stanislaus National Forest 9 years; Forester, Shasta-Trinity National Forest 2 years
Team Responsibility: ID Team Leader

Ken C. Boucher Jr.

Education: Biological Sciences Certificate, University of Las Vegas 2007
Experience: Fire Management Specialist, Rogue-River Siskiyou National Forest 1 year, Fuels Planner, South Fork Management Unit Shasta-Trinity National Forest 23 years
Team Responsibility: Fire and Fuels

Scott T. Cones

Experience: Assistant District Fire Management Officer (Fuels), Stanislaus National Forest 4 years; Fuels Technician, Stanislaus National Forest 4 years; Forestry Technician (Fire), Stanislaus National Forest 8 years
Team Responsibility: Fire and Fuels

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Education: B.S. Rangeland Resource Science (Botany minor), CSU Humboldt 2005; M.S. Natural Resources Sciences (Rangeland Resources and Wildland Soils), CSU Humboldt 2007
Experience: Rangeland Management Specialist, Stanislaus National Forest 5 years; Staff Biologist, Integrated Environmental Services 1 year; Junior Specialist, UC Davis Plant Sciences 5 years; Biological Technician, Adaptive Management Services Enterprise 3 years
Team Responsibility: Range

Mary Ellen Emerick

Education: B.A. Writing, Michigan State University 1985. Graduate and undergraduate level coursework in Biology, Wilderness and Recreation Management and related fields, Oregon State University 2002-2004

Experience: Recreation Planner, Integrated Resources Enterprise 4 years; Outdoor Recreation Planner, BLM 5 years; Wilderness Manager, Tongass National Forest 7 years; North Zone Recreation Staff Officer, Wallowa-Whitman National Forest 3 years; Seasonal wilderness ranger, Sawtooth National Recreation Area 5 years; Chair and board member, Chief's Wilderness Advisory Group 4 years

Team Responsibility: Recreation, Wild and Scenic Rivers and Wilderness

Lisa DeHart

Education: B.A. Anthropology (Prehistoric Archaeology), California State University Stanislaus 1984

Experience: District Archaeologist, Stanislaus National Forest 24 years; Archaeological Technician/Archaeologist, Stanislaus National Forest 1 year; Commissioner, Tuolumne County Historic Preservation Review Commission 22 years; Archaeologist survey and excavation crews in California, Nevada, Montana and Australia 8 years

Team Responsibility: Cultural Resources

Marty Gmelin

Education: A.S. Forestry, Paul Smith's College NY 1986; B.S Forest Management, University of Montana 1989; Forest Service Certified Silviculturist 2011

Experience: Forest Silviculturist, Stanislaus National Forest 2 years; Resource Management Program Area Leader, Stanislaus National Forest 8 years; Reforestation Forester, Stanislaus National Forest 8 years; Image Analyst, Northern Region 4 years; Regional Snow Survey Coordinator, Pacific Southwest Region 14 years

Team Responsibility: Silviculture

Carly Gibson

Education: B.A. Environmental Studies (Natural History and Conservation Biology), University of California Santa Cruz 2000. M.S. Forest Resources (Fire Ecology), University of Idaho 2006

Experience: GIS Resource Specialist, Stanislaus National Forest 5 years; Ecologist, Beaverhead-Deerlodge National Forest 4 years; Research Assistant, University of Idaho 2 years; Biologist, Cleveland National Forest 1 year; Restoration Ecologist, San Bernardino National Forest 3 years; Biologist, Merkel and Associates 1 year

Team Responsibility: Ecology

Curtis Kvamme

Education: B.S. Natural Resources Ecology and Conservation Biology (Forest Resources minor), University of Idaho 2006; M.S. Forest Ecology and Management, Michigan Technological University 2010

Experience: Soil Scientist, Stanislaus National Forest 5 years; Soil Scientist Student Career Experience Program (SCEP), Shoshone National Forest 2 years

Team Responsibility: Soils

John Maschi

Education: B.S. Landscape Architecture, Rutgers University 1976; Master of Landscape Architecture (Regional Planning), University of Illinois 1978

Experience: Forest Planner, Stanislaus National Forest 19 years; Assistant Recreation Officer 6 years; Landscape Architect 11 years

Team Responsibility: Land Management Planning and NEPA

Christopher Mease

Education: B.S. Biology, Oregon State University 1997
Experience: Aquatics Biologist, Forest Service TEAMS Enterprise 5 years; Assistant Forest Aquatics Biologist, Stanislaus National Forest 2 years; Fisheries Biologist, Tahoe National Forest 9 years
Team Responsibility: Aquatic Species

Terry Miller

Education: B.A. Plant Biology, Southern Illinois University Carbondale 2000; M.S. Forest Resources University of Idaho Moscow 2004
Experience: Botanist, TEAMS Enterprise 7 years; Forest Botanist, Hiawatha National Forest 2 years; District Botanist, Plumas National Forest 4 years; SCEP Botanist, Fishlake National Forest 2 years
Team Responsibility: Botanical Resources

Fernando Perez

Education: A.A. Pre-Medical, University of Puerto Rico Ponce 1997; B.S. Natural Sciences General, University of Puerto Rico Cayey 2002
Experience: District Hydrologist, Stanislaus National Forest 9 years; Hydrologist Trainee, Caribbean National Forest 3 years
Team Responsibility: Hydrology

Chris Sorensen

Education: B.S. Forestry (Ecological Restoration), Northern Arizona University 2008; M.S. Forestry (Silviculture, Forest Carbon and Natural Resource Economics), Northern Arizona University 2010
Experience: Planning Forester, Stanislaus National Forest 5 years; Data Management Assistant, Southern Colorado Plateau Inventory and Monitoring Network, National Park Service 1 year; Research Assistant, Ecological Restoration Institute 3 years
Team Responsibility: Silviculture

Jan Spencer

Education: A.S. Northwest Community College, 1985; Bachelor of Landscape Architecture, Utah State University 1988
Experience: Landscape Architect, Forest Service TEAMS Enterprise 13 years; Environmental Analysis (scenery management), Forest Service 20 years; Landscape Architect, White River National Forest 10 years
Team Responsibility: Visual Resources

Steven Spickard

Education: B.A. Economics, University of California Berkeley 1974; M.C.P. College of Environmental Design, University of California Berkeley 1978
Experience: Consulting in Economics, Sole Proprietor of Land Economics Consultants 5 years; Sr. V.P., AECOM 3 years; Principal, Economics Research Associates 29 years; Research Analyst, Stanford Research Institute 2 years
Team Responsibility: Social, Culture and Economy

Karen Walden

Education: B.S. Forest Resources Management, Humboldt State University 1984
Experience: Writer/Editor, Stanislaus National Forest 2 years; Forester/Resource Management Planning, Tahoe National Forest 8 years; Forester (private) 7 years.
Team Responsibility: Writer/Editor

Federal, State and Local Agencies

Advisory Council on Historic Preservation
California Department of Fish and Wildlife
California Farm Bureau Federation
City and County of San Francisco Hetch Hetchy Water and Power
City of San Jose
Mariposa County Board of Supervisors
Modesto Irrigation District
San Francisco Public Utilities District
Tuolumne County Board of Supervisors
Turlock Irrigation District
USDI Environmental Protection Agency
USDI Fish and Wildlife Service
Yosemite National Park

Organizations

American Forest Resource Council
American Motorcyclist Association, District 36
Blue Mountain Minerals
California Forestry Association
California Native Plant Society (Local Chapter)
Tawonga Jewish Community Corporation
Central Sierra Audubon Society
Central Sierra Environmental Resource Center
CT Bioenergy Consulting
Forest Cattle Permittees
Friends of Berkeley Camp
Friends of Camp Mather
Gold Rush News
James R. Dambacher Construction
Merced Dirt Riders/4x4 in Motion
Mule Deer Foundation
SBC Pacific Bell
Rim Fire Technical Workshop
Sierra Forest Legacy
Sierra Pacific Industries
Sierra Trek
Stanislaus Trail Bike Association
Tuolumne County Alliance for Resources and the Environment (TuCARE)
Tuolumne County Farm Bureau
Tuolumne County Sportsmen
Tuolumne Group Sierra Club
Tuolumne River Trust
Yosemite Deer Herd Advisory Council
Yosemite Stanislaus Solutions (YSS)

Tribes

Tuolumne Band of Me-Wuk Indians

4.02 Distribution of the EIS

The Forest Service is circulating either the EIS or a notice of the availability of the EIS to: any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved and any appropriate Federal, State or local agency authorized to develop and enforce environmental standards; the applicant, if any; any person, organization, or agency requesting the entire EIS; and, in the case of a final EIS any person, organization, or agency which submitted substantive comments on the DEIS (40 CFR 1502.19).

Federal, State and Local Agencies

Federal Agencies

Advisory Council on Historic Preservation, Director, Planning and Review
Federal Aviation Administration, Western-Pacific Region Regional Administrator
Federal Highway Administration
National Marine Fisheries Service Habitat Conservationists Division Southwest Region
US Army Corp of Engineers
US Coast Guard, Environmental Management
US Department of Energy, Director, Office of NEPA Policy and Compliance
US Environmental Protection Agency, Region 9 EIS Review Coordinator
USDA APHIS PPD/EAD
USDA National Agricultural Library Head Acquisitions and Serials Branch
USDA Natural Resources Conservation Service, National Environmental Coordinator
USDA Office of Civil Rights
USDI Fish and Wildlife Service
USDI Office of Environmental Policy and Compliance

California State Agencies

California Department of Fish and Wildlife
California Department of Transportation
State Water Resources Control Board (California)
State of California Sierra Nevada Conservancy
State Clearinghouse (California)

Local Agencies

Modesto Irrigation District
San Francisco, Hetch Hetchy Water and Power
San Francisco Public Utilities Commission
Tuolumne Utilities District
Turlock Irrigation District

Elected Officials

Federal Officials

Congressman Jeff Denham
Congressman Tom McClintock
Senator Barbara Boxer
Senator Dianne Feinstein

California State Officials

Kristen Olsen, California Assembly
Frank Bigelow, California Assembly
Tom Berryhill, California Senate

Local Officials

Connie Williams, City of Sonora Council
Mariposa County Board of Supervisors
Tuolumne County Board of Supervisors

Tribes

Tuolumne Band of Me-Wuk Indians

Organizations

American Forest Resource Council
Calforests, California Forestry Association
California Chaparral Institute
California Native Plant Society
Center for Biological Diversity
Central Sierra Audubon Society
Central Sierra Environmental Resource Center
Defenders of Wildlife
Forest Issues Group
John Muir Project of Earth Island Institute
Sierra Foothills Audubon Society
Sierra Forest Legacy
Sierra Pacific Industries
Tawonga Jewish Community Corporation
Tuolumne County Farm Bureau
Tuolumne Group Sierra Club
Tuolumne River Trust
Western Watersheds Project
Wilderness Society
Yosemite Stanislaus Solutions

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A. Abbreviations and Acronyms

ACHP	Advisory Council on Historic Preservation
AMS	Aquatic Management Strategy
APCD	Air Pollution Control District
APE	Area of Potential Effects
BA	Biological Assessment
BACM	Best Available Control Measure
BAER	Burned Area Emergency Response
BE	Biological Evaluation
BF	Board Feet
BLM	Bureau of Land Management
BMI	Benthic Macro Invertebrate
BMP	Best Management Practice
BTU	British Thermal Unit
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CAR	Critical Aquatic Refuge
CARB	California Air Resources Board
CDFW	California Department of Fish and Wildlife
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CSO	California Spotted Owl
CNDDB	California Natural Diversity Database
CRPR	California Rare Plant Rank
CWD	Coarse Woody Debris
CWE	Cumulative Watershed Effect
CWHR	California Wildlife Habitat Relationships
DBH	Diameter at Breast Height
DEIS	Draft Environmental Impact Statement
DEM	Digital Elevation Model
DTFC	Deep Till with Forest Cultivation
EA	Environmental Assessment
EEC	Expected Environmental Concentration
EHR	Erosion Hazard Rating
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERA	Equivalent Roaded Acres
ESA	Endangered Species Act of 1973
FB	Feller Buncher
FS	Forest Service
FFE	Fire and Fuels Extension
FOFEM	First Order Fire Effects Model

FSH	Forest Service Handbook
FSM	Forest Service Manual
FSS	Forest Service Sensitive
FYLF	Foothill Yellow-Legged Frog
GIS	Geographic Information System
GRUB	Hand Removal
GTR	General Technical Report
HC	Hand Cut
HCRA	Home Range Core Area
HERB	Manual Herbicide Application
HFC	Hydrologic Function Class
HP	Hand Pile
HQ	Hazard Quotient
HR	Heritage Resources
HSA	Hydrologically Sensitive Area
HT	Hazard Trees
HUC	Hydrologic Unit Code
ID	Interdisciplinary
IDT	Interdisciplinary Team
ICO	Individuals, Clumps and Openings
INFRA	Infrastructure Database
IPM	Integrated Pest Management
IRA	Inventoried Roadless Area
JP	Jackpot Burning
LOP	Limited Operating Period
MA	Masticate
MBF	Thousand Board Feet
MCL	Maximum Contaminant Level
MMBF	Million Board Feet
MBTA	Migratory Bird Treaty Act
MIS	Management Indicator Species
ML	Maintenance Level
MOI	Memorandum of Intent
MOU	Memorandum of Understanding
MP	Machine Pile
MYLF	Mountain Yellow-Legged Frog
NAAQS	National Ambient Air Quality Standards
NAT	Natural Regeneration
NEPA	National Environmental Policy Act
NF	National Forest
NFMA	National Forest Management Act
NFS	National Forest System
NFSR	National Forest System Road
NFST	National Forest System Trail
NHPA	National Historic Preservation Act

NNIS	Non-native Invasive Species
NOAEL	No Observable Adverse Effect Level
NOEC	No Observable Effect Concentration
NOI	Notice of Intent
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRIS	Natural Resource Information System
NVUM	National Visitor Use Monitoring
OFEA	Old Forest Emphasis Area
OHV	Off-Highway Vehicle
PA	Programmatic Agreement
PAC	Protected Activity Center
PCE	Primary Constituent Element
PCT	Pre-Commercial Thin
PF	Prescribed Fire
PM	Particulate Matter
PNB	Present Net Benefit
PNC	Present Net Cost
PNV	Present Net Value
PPF	Post-planting Prescribed Fire
PSW	Pacific Southwest Research Station
R5	Forest Service Region 5
RAVG	Rapid Assessment of Vegetation Condition after Wildfire
RCA	Riparian Conservation Area
RCO	Riparian Conservation Objective
RD	Ranger District
RNA	Research Natural Area
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
SAF	Special Aquatic Feature
SDI	Stand Density Index
SDV	Soil Data Viewer
SFMA	Strategic Fire Management Area
SFMF	Strategic Fire Management Feature
SHPO	State Historic Preservation Officer
SIA	Special Interest Area
S&G	Standard and Guideline
SMP	Smoke Management Program
SMS	Scenery Management System
SNFPA	Sierra Nevada Forest Plan Amendment
SNYLF	Sierra Nevada Yellow-Legged Frog
SOM	Soil Organic Matter
SOPA	Schedule of Proposed Actions
SPM	Semi-Primitive Motorized
SPNM	Semi-Primitive Non-Motorized

SSI	StreamScape Inventory
STF	Stanislaus National Forest
SUP	Special Use Permit
TE	Threatened and Endangered
TES	Threatened, Endangered and Sensitive
TOC	Threshold of Concern
TPA	Trees Per Acre
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
VELB	Valley Elderberry Longhorn Beetle
VMS	Visual Management System
VQO	Visual Quality Objective
WSA	Watershed Sensitive Area

B. Cumulative Effects Analysis

According to the CEQ NEPA regulations, "cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR 1508.7).

The Forest Service queried databases, including the Schedule of Proposed Actions (SOPA) to determine past, present and reasonably foreseeable future actions (future actions) on Forest Service lands, other Federal (non-Forest Service) lands, and private lands. This Appendix lists the specific findings and information used for the cumulative effects analysis described in 3.01 Introduction and presented for each Chapter 3 resource section. The Cumulative Effects Analysis Map (project record) shows the location of the present and future land disturbance actions described in this Appendix.

Past Actions

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. Existing conditions reflect the aggregate impact of all prior human actions and natural events that affected the environment and might contribute to cumulative effects. This cumulative effects analysis does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis for three reasons:

- First, a catalog and analysis of all past actions would be impractical to compile and unduly costly to obtain. Innumerable actions over the last century (and beyond) impacted current conditions and trying to isolate the individual actions with residual impacts would be nearly impossible.
- Second, providing the details of past actions on an individual basis would not be useful to predict the cumulative effects of the proposed action or alternatives. In fact, focusing on individual actions would be less accurate than looking at existing conditions, because information on the environmental impacts of individual past actions is limited, and one cannot reasonably identify each and every action over the last century that contributed to current conditions. Additionally, focusing on the impacts of past human actions ignores the important residual effects of past natural events which may contribute to cumulative effects just as much as human actions. By looking at current conditions, we are sure to capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed those effects.
- Finally, the CEQ issued an interpretive memorandum on June 24, 2005 regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions" (CEQ 2005).

The cumulative effects analysis in this EIS is consistent with Forest Service NEPA regulations on cumulative effects analysis (36 CFR 220.4(f)), which state:

> Cumulative effects analysis shall be carried out in accordance with 40 CFR 1508.7 and in accordance with "The Council on Environmental Quality Guidance Memorandum on Consideration of Past Actions in Cumulative Effects Analysis" dated June 24, 2005. The analysis of cumulative effects begins with consideration of the direct and indirect effects on the environment that are expected or likely to result from the alternative proposals for agency action. Agencies then look for present effects of past actions that are, in the judgment of the agency, relevant and useful because they have a significant cause-and-effect relationship with the direct and indirect effects of the proposal for agency action and its alternatives. CEQ regulations do not require the consideration of

> the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonably foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making. (40 CFR 1508.7).

For those reasons, past actions are considered part of the existing condition described in the "Affected Environment" under each Chapter 3 resource section.

PRESENT ACTIONS

Present actions within the Rim Reforestation cumulative effects analysis area are described below. Present actions are those underway and currently affecting resources including: ongoing activities; Forest Service and other Federal land disturbance actions with completed NEPA decisions that are not yet fully implemented; and, private land disturbance actions.

Ongoing Activities

Ongoing activities on NFS lands within the Rim Fire perimeter include, but are not limited to:

Facility Maintenance: maintain, repair or replace existing improvements at administrative sites, recreation sites, roads, trails and other facilities with activities including, but are not limited to: block unauthorized routes; hand-treat roadside weeds and spot treat small roadside areas of spotted knapweed with herbicide (glyphosate); plant native plants; and, replace or repair culverts and fences.

Livestock Grazing: 14 grazing allotments are either wholly or partially within the cumulative effects analysis area as defined previously, covering about 152,560 acres. The maximum number of cattle run across all the allotments is about 1,632 cow/calf pairs in any given season.

Recreation: recreation is abundant in the area and consists of activities including, but not limited to Off Highway Vehicle (OHV) use, passenger car driving, wood cutting, camping (dispersed and developed), hiking, cycling (mountain and road), fishing, backpacking, horseback riding, and winter sports.

Present Forest Service Land Disturbance Actions

The present actions on NFS lands within the Rim Reforestation cumulative effects analysis area are described below. Table B.01-1, which lists the present disturbance actions on NFS lands, provides the total overall project acres, miles or quantities along with the project acres, miles or quantities within the Rim Fire perimeter.

Developed Facilities

Rim Hazard Tree: hazard tree removal and fuels reduction within and adjacent to facilities including 194 miles of high-use roads; private property; developed sites; recreation use areas; and powerlines.

Ecological Restoration

Rim Habitat: restore 10 springs; restore 32 acres of meadows and streams; install 30-50 great gray owl nest structures; hand treat 300 acres of weeds; protect and restore habitat for mountain ladyslipper in 8 locations; remove encroaching conifers on 397 acres of special aquatic features;

reconfigure a fence near Jawbone Station; and, improve western pond turtle habitat on up to 1 acre of upland and 1,600 feet of stream channel.

Rim Recovery: in areas burned in the Rim Fire, fuels treatments include: biomass removal; mastication; drop and lop; machine piling and burning; and/or, jackpot burning on 26,889 acres.

Timber Harvest

Groovy Stewardship: thinning (mechanical and hand) and biomass removal to increase structural diversity, improve wildlife habitat, and encourage pine and hardwoods. Contract was modified to include salvage logging of dead trees burned in the Rim Fire.

Transportation

Mi-Wok OHV Restoration: block and restore unauthorized OHV routes and impact areas; install barriers at beginning of blocked routes; designate rock barrier source at Bourland and Coffin Quarries.

Table B.01-1 Present disturbance actions on NFS lands

Project/Activity	Action	Acres[1]	Acres[2]	Miles[1]	Miles[2]	QTY[1]	QTY[2]	Decision (year)
Rim Hazard Trees	Maintain roads and facilities	10,315	10,315	194.0	194.0	NA	NA	2014
Subtotal Developed Facilities		**10,315**	**10,315**	**194.0**	**194.0**	**NA**	**NA**	
Rim Habitat	Install Great gray owl nest structures	NA	NA	NA	NA	30	30	2015
Rim Habitat	Restore springs and streams	NA	NA	0.3	0.3	10	10	2015
Rim Habitat	Restore aspen (remove conifers)	397	397	NA	NA	NA	NA	2015
Rim Habitat	Treat weeds (no herbicides)	300	300	NA	NA	NA	NA	2015
Rim Habitat	Restore meadows (hand work)	32	32	NA	NA	NA	NA	2015
Rim Recovery	Treat fuels	26,889	NA	NA	NA	NA	NA	2014
Subtotal Ecological Restoration		**27,618**	**729**	**0.3**	**0.3**	**40**	**40**	
Groovy Stewardship	Thin green trees	1,319	1,319	NA	NA	NA	NA	2012
Subtotal Timber Harvest		**1,319**	**1,319**	**NA**	**NA**	**NA**	**NA**	
Mi-Wok OHV Restoration	Block and restore routes and areas	4	1	11.6	0.5	11	1	2012
Subtotal Transportation		**4**	**1**	**11.6**	**0.5**	**11**	**1**	
Totals		**39,256**	**12,364**	**205.9**	**194.8**	**51**	**41**	

NFTS=National Forest Transportation System; QTY=Quantity
[1] Total overall project acres, miles or quantities.
[2] Project acres, miles or quantities within the Rim Fire perimeter.

Private Land Disturbance Actions

The present land disturbance actions on private lands that are on file with California Department of Forestry and Fire Protection (Cal Fire) includes herbicide use on 9,719 acres.

REASONABLY FORESEEABLE FUTURE ACTIONS

Forest Service NEPA regulations define future actions as: “Those Federal or non-Federal activities not yet undertaken, for which there are existing decisions, funding, or identified proposals” (36 CFR 220.3). The regulations go on to describe an “identified proposal” as a situation in which “[t]he Forest Service has a goal and is actively preparing to make a decision on one or more alternative means of accomplishing that goal and the effects can be meaningfully evaluated” [40 CFR 1508.23; 36 CFR 220.4(a)(1)]. In practice, an action becomes reasonably foreseeable and subject to meaningful evaluation when the agency has written a proposal and has circulated that proposal for public scoping (40 CFR 1501.7).

Future actions within the Rim Reforestation cumulative effects analysis area are described below. These include future Forest Service and other Federal land disturbance actions; and, future private land disturbance actions.

Future Forest Service Land Disturbance Actions

The future actions on NFS lands within the Rim Reforestation cumulative effects analysis area are described below. Table B.01-2, which lists the reasonably foreseeable future disturbance actions on NFS lands, provides the total overall project acres, miles or quantities along with the project acres, miles or quantities within the Rim Fire perimeter.

Developed Facilities

City of Berkeley Tuolumne Camp: issue a Special Use Permit (SUP) for reconstruction, occupancy, use and maintenance of the City of Berkeley Tuolumne Camp which was completely destroyed by the 2013 Rim Fire.

Ecological Restoration

Reynolds Creek Aspen: aspen stand improvement/expansion involving the removal of encroaching conifers. Treatments proposed in 2 stands for 2 acres include thinning (mechanical and hand), biomass removal, removal of encroaching conifers, repairing gullies and stabilizing streambeds.

Reynolds Creek Fuels: prescribed burning within and adjacent to Reynolds Creek Stewardship thinning units.

Reynolds Creek Meadows: meadow treatments including headcut repair, fencing, removal of encroaching conifers, and planting of riparian vegetation. Treatments proposed in 8 meadows for 14 acres include thinning (mechanical and hand), biomass removal, removal of encroaching conifers, repairing gullies and stabilizing streambeds.

Rim Rehabilitation: repair or improve habitat and natural resources affected by the Rim Fire by installing 2 guzzlers and 21 wildlife-friendly troughs; removing encroaching conifers on 32 acres of aspen stands; decommissioning 2 miles of unauthorized routes; and, 157 acres of meadow and stream restoration.

Twomile Meadows: improve meadow function in five meadows and associated streams by raising water tables nearer to natural levels. Treatments include stabilizing banks and headcuts, revegetation with native species and subsoiling compacted areas.

Timber Harvest

Campy Timber Sale: thinning (mechanical and hand) and biomass removal to increase structural diversity, improve wildlife habitat, and encourage pine and hardwoods.

Funky Stewardship: thinning (mechanical and hand) and biomass removal to increase structural diversity, improve wildlife habitat, and encourage pine and hardwoods.

Looney Timber Sale: thinning (mechanical and hand) and biomass removal to increase structural diversity, improve wildlife habitat, and encourage pine and hardwoods.

Reynolds Creek Stewardship: thinning (mechanical and hand) and biomass removal to increase structural diversity, improve wildlife habitat, and encourage pine and hardwoods.

Soldier Creek Timber Sale: thinning (mechanical and hand) and biomass removal to increase structural diversity, improve wildlife habitat, and encourage pine and hardwoods.

Thommy Timber Sale: thinning (mechanical and hand) and biomass removal to increase structural diversity, improve wildlife habitat, and encourage pine and hardwoods.

Transportation

Ferretti OHV Restoration: block and restore unauthorized routes and impact areas, construct reroutes and new trails, and install barriers.

Reynolds Creek Motorized Routes: decommission unauthorized motorized routes.

Reynolds Creek Transportation: replace and maintain culverts to improve aquatic passage and hydrologic function. Decommission, close, reconstruct, trail reroute and complete watershed rehabilitation.

Rim Rehabilitation: decommission and block routes.

Twomile Transportation: install gates, close 11 segments, decommission 14 segments, maintain 23 segments, construct one new segment, and reconstruct 9 segments.

Table B.01-2 Reasonably foreseeable future disturbance actions on NFS lands

Project/Activity	Action	Acres[1]	Acres[2]	Miles[1]	Miles[2]	QTY[1]	QTY[2]	Decision (year)
City of Berkeley Tuolumne Camp	Issue special use permit	25	25	NA	NA	1	1	pending
Subtotal Developed Facilities		**25**	**25**	**NA**	**0.0**	**1**	**1**	
Reynolds Creek Aspen	Restore aspen (remove conifers)	16	13	NA	NA	NA	NA	2012
Reynolds Creek Fuels	Prescribed burn	2,324	2,288	NA	NA	NA	NA	2012
Reynolds Creek Meadows	Restore meadows	15	15	NA	NA	NA	NA	2012
Rim Rehabilitation	Restore aspen (remove conifers)	32	32	NA	NA	NA	NA	2015
Rim Rehabilitation	Restore meadows and streams	157	157	NA	NA	NA	NA	2015
Rim Rehabilitation	Install troughs and guzzlers	NA	NA	NA	NA	23	23	2015
Twomile Meadows	Restore meadows	11	4.5	NA	NA	NA	NA	2012
Subtotal Ecological Restoration		**2,555**	**2,510**	**NA**	**NA**	**23**	**23**	
Campy Timber Sale	Thin green trees	1,069	1,069	NA	NA	NA	NA	2012
Funky Stewardship	Thin green trees	1,073	631	NA	NA	NA	NA	2012
Looney Timber Sale	Thin green trees	1,445	381	NA	NA	NA	NA	2012
Reynolds Creek Stewardship	Thin green trees	952	952	NA	NA	NA	NA	2012
Soldier Creek Timber Sale	Thin green trees	250	250	NA	NA	NA	NA	2008
Thommy Timber Sale	Thin green trees	670	670	NA	NA	NA	NA	2012
Subtotal Timber Harvest		**5,459**	**3,953**	**NA**	**NA**	**NA**	**NA**	
Ferretti OHV Restoration	Block and restore routes	71	71	6.0	6.0	18	18	2015
Reynolds Creek Motorized Routes	Decommission unauthorized	NA	NA	3.5	3.5	14	14	2013
Reynolds Creek Transportation	Improve roads, trails and culverts	NA	NA	12.5	12.5	NA	NA	2013
Rim Rehabilitation	Block and restore routes	NA	NA	2.1	2.1	8	8	2015
Twomile Transportation	Changes to the NFTS	NA	NA	29.2	29.2	NA	NA	pending
Subtotal Transportation		**71**	**71**	**53.3**	**53.3**	**40**	**40**	
Totals		**8,110**	**6,559**	**53.3**	**53.3**	**64**	**64**	

NFTS=National Forest Transportation System; QTY=Quantity
[1] Total overall project acres, miles or quantities.
[2] Project acres, miles or quantities within the Rim Fire perimeter.

Future Private Land Disturbance Actions

Reasonably foreseeable land disturbance actions on private lands that are on file with California Department of Forestry and Fire Protection (Cal Fire) within the Rim Fire perimeter include permits for herbicide use covering 5,760 acres.

C. Glossary

90th Percentile Weather Conditions	High air temperature, low relative humidity, strong wind conditions and low fuel moisture content levels that historically that are met or exceeded on 10 percent of days during the fire season. It defines potential fire behavior as a result of these conditions: a 90th percentile weather day has the potential for severe wildfire behavior.
Activity Generated Fuel	Fuel resulting from, or altered by, management practices such as timber harvesting, thinning, or road construction.
Adaptive Capacity	The ability of ecosystems to respond, cope or adapt to disturbances and stressors, including environmental change, to maintain options for future generations. As applied to ecological systems, adaptive capacity is determined by genetic diversity of species, biodiversity within a particular ecosystem, and heterogeneous ecosystem mosaics as applied to specific landscapes or biome regions.
Adaptive Management	A system of management practices based on clearly identified intended outcomes and monitoring to determine if management actions are meeting those outcomes; and, if not, to facilitate management changes that will best ensure that those outcomes are met or re-evaluated. Adaptive management stems from the recognition that knowledge about natural resource systems is sometimes uncertain (36 CFR 220.3).
Administrative Unit	A National Forest, a National Grassland, a purchase unit, a land utilization project, Columbia River Gorge National Scenic Area, Land Between the Lakes, Lake Tahoe Basin Management Unit, Midewin National Tallgrass Prairie, or other comparable unit of the National Forest System.
Affected Environment	The physical, biological, social and economic environment within which human activity is proposed.
Alluvial	Pertaining to processes or materials associated with transportation or deposition by running water.
Alternative	One of several policies, plans or projects proposed for decision making.
Aquatic	Growing or living in or frequenting water; taking place in or on water.
Aquatic Ecosystem	A stream channel, lake or estuary bed, the water itself, and the biotic (living) communities that occur therein.
ARC/INFO	The name of a Geographic Information System software program.
Area of Potential Effects (APE)	This is the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking.
Aspect	The direction a slope faces. For example, a hillside facing east has an eastern aspect.
Basal Area	The total cross-sectional area of all stems, including the bark, in a given area, measured at breast height (4.5 feet above the ground). Usually given in units of square feet per acre.
Beneficial Uses of Water	Uses of water that are protected against degradation as described in the Basin Plan of the California Central Valley Regional Water Quality Control Board. These uses include municipal, agriculture, industry, recreation and aquatic and wildlife habitat categories.
Best Management Practices (BMPs)	Water Quality Best Management Practices, a codified series of about 100 practices for protecting water quality when conducting forest management activities. BMPs are referenced in R5 FSH 2509.22, Soil and Water Conservation Handbook; Chapter 10, Water Quality Management Handbook.

Biological Assessment	An evaluation of the effects of a proposal on threatened, endangered or proposed species in accordance with legal requirements under Section 7 of the Endangered Species Act. An evaluation of the effects of a proposal on threatened, endangered, and proposed species for non-construction activities.
Biological Diversity (Biodiversity)	The number and abundance of species found within a common environment. This includes the variety of genes, species, ecosystems, and the ecological processes that connect everything in a common environment.
Biological Evaluation	A documented Forest Service review of Forest Service programs or activities done in conjunction with the NEPA process in sufficient detail to determine whether a proposed action will result in a trend toward a sensitive species becoming Federally listed.
Biomass	Trees less than 10 inches dbh not used as sawlogs. This material is usually chipped and/or removed from the project area and hauled to a mill to be used for cogeneration of energy or as fiber for wood products.
Biota	The plant and animal life of a particular region.
Biotic Potential	Factors that influence the ability of an animal to utilize its environment, including: reproductive rates, dispersal ability, habitat and life requisite specificity, and adaptability. Combine, these factors assign biotic potential of the animal.
Blue Oak Woodlands	An ecosystem dominated by blue oak, valley oak, interior live oak (tree form), or Oregon white oak.
Board Feet	A unit of measure of sawlog volume, equivalent to 12 inches by 12 inches by 1 inch. One thousand board feet is denoted as mbf.
Buffer	Used in the context of GIS; a buffer is a zone of a specified distance around a feature in a coverage.
Burned Area Emergency Response (BAER)	BAER is a Forest Service activity of immediate post-wildfire response to assess and reduce the risk of loss of human life, property damage, and adverse effects to critical natural and cultural resources from threats caused by the fire.
Burning Prescription	Written direction stipulating fire environment conditions, techniques, and administrative constraints necessary to achieve specified resource management objectives by use of fire on a given area of land.
California Wildlife Habitat Relationships (CWHR)	A system of classifying vegetation in relation to its function as wildlife habitat. Tree-dominated habitat is classified according to tree size and canopy closure.
Canopy	The part of any stand of trees represented by the tree crowns. It usually refers to the uppermost layer of foliage, but it can be used to describe lower layers in a multi-storied forest.
Canopy cover	The degree to which the canopy (forest layers above one's head) blocks sunlight or obscures the sky. Same as crown closure.
Capability	The potential of land to produce resources, and supply goods and services under a set of management practices and at a govern level of management intensity. Capability depends upon site conditions such as climate, soils, and geology, as well as the application of management practices, such as silviculture.
Capable Forest Land	Those portions of the forest that have an inherent ability to support trees for timber harvest and produce at least 20 cubic feet per acre per year of wood fiber.
Capable Rangeland	Land that can sustain domestic grazing and generally represent the portions of the landscape assumed to be most commonly used by cattle
Chief	The Chief, Forest Service, Department of Agriculture (36 CFR 212).
Code of Federal Regulations (CFR)	A codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government.
Collaboration	Managers, scientists and citizens working together to plan, implement and monitor National Forest management. The intention is to engage people who have information, knowledge, expertise and an interest in the health of National Forest ecosystems and nearby communities.
Competing Vegetation	Any plant that reduces availability of water, nutrients, light and physical growing space to desired vegetation (e.g., natural or artificial conifer regeneration).

Complex Early Seral	Complex early seral forest follows stand-replacing disturbance in a mature forest and is characterized by abundant snags and downed logs, natural conifer regeneration, and development of a diverse understory community of post-disturbance vegetation and associated wildlife (Della Sala et al. 2014).
Connected Actions	Actions that: (i) automatically trigger other actions which may require environmental impact statements; (ii) cannot or will not proceed unless other actions are taken previously or simultaneously; or, (iii) are interdependent parts of a larger action and depend on the larger action for their justification (40 CFR 1508.25).
Connectivity (of Habitats)	The linkage of similar but separated vegetation stands by patches, corridors, or “stepping stones” of like vegetation. This term can also refer to the degree to which similar habitats are linked.
Coverage	A digital map or layer of data in the ARC/INFO software program.
Council on Environmental Quality (CEQ)	The Council on Environmental Quality established by Title II of NEPA (40 CFR 1508.6).
Critical Aquatic Refuge (CAR)	A relatively small watershed, ranging in size from about 3,000 to 85,000 acres, that is sometimes nested within an emphasis watershed and has localized populations of rare and/or at-risk populations of native fish and/or amphibians.
Critical Deer Winter Range	Critical habitat area where the highest concentrations of a deer are found during winter and where habitat condition directly affects the viability of the population.
Critical Habitat	Areas designated for the survival and recovery of federally listed threatened or endangered species.
Crown closure	Refer to canopy cover.
Crown fire	A fire that advances through the canopy of trees or shrubs independently of the surface fire.
Cryptogamic Soil Crusts	Biological soil crust composed of living cyanobacteria, green algae, brown algae, fungi, lichens, and/or mosses.
Cumulative Impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).
Coarse Woody Debris (CWD)	Coarse woody debris is 1,000 hour dead fuel, with a minimum diameter (or an equivalent cross section) of 3 inches at the widest point and includes sound and rotting logs, standing snags, stumps, and large branches (located above the soil).
Cultural Resources	An object, site structure or location associated with past human activity or important to contemporary ethnic groups or individuals.
Decommission	Activities that result in the stabilization and restoration of unneeded roads or trails to a more natural state (FSM 7703.2(1)).
Deep Tilling	Also known as subsoiling. Mechanical lifting and shattering of the layer of soil beneath the topsoil in order to reduce soil density and strength, improve moisture infiltration and retention, and increase root penetration in the soil.
Designated Road, Trail or Area	A National Forest System road, trail or area that is designated for motor vehicle on a motor vehicle use map (36 CFR 212).
Desired Future Conditions	Land or resource conditions that are expected to result based on goals and objectives.
Diameter at Breast Height (DBH)	The diameter of a tree trunk 4.5 feet above the ground.
Digital Elevation Model (DEM)	A digital GIS file typically used to represent terrain relief.
Disjunct	A population of plants or animals which are separated by a large distance from the typical distribution of the species.
Draft Environmental Impact Statement (DEIS)	A detailed written statement as required by section 102(2) (C) of the NEPA (40 CFR 1508.11) that is released to governmental agencies and the general public for review and comment.

Drop and Lop	A treatment that involves felling non-merchantable trees less than about 10 inches dbh and lopping them into pieces small enough to ensure the material is not stacked and has as much ground contact as practical.
Duff	The layer of partially and fully decomposed organic material lying below the litter and immediately above the mineral soil.
Early Forest Succession	The biotic (or life) community that develops immediately following the removal or destruction of vegetation in an area. For example, grasses may be the first plants to grow in an area that was burned.
Ecological Integrity	The quality or conditions of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence.
Ecology	The interrelationships of living things to one another and to their environment, or the study of these interrelationships.
Ecosystem	An arrangement of living and non-living things and the forces that move them. Living things include plants and animals. Non-living parts of ecosystems may be rocks and minerals. Weather and wildfire are two of the forces that act within ecosystems.
Endangered Species	Those plant or animal species that are in danger of extinction throughout all or a significant portion of their range. Endangered species are identified by the Secretary of the Interior in accordance with the Endangered Species Act of 1973.
Endemic	An organism that evolved in and is restricted to a particular locality. The Little Kern golden trout found only in the Sierra Nevada region is an example.
Endlining	Moving logs using cables where the log is in full or partial contact with the ground.
Environmental Justice	The state (or condition) which all populations are provided the opportunity to comment before decisions are rendered on, are allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner by government programs and activities affecting human health or the environment.
Environmental Impact Statement (EIS)	A detailed written statement as required by section 102(2) (C) of NEPA (CFR 1508.11).
Environmentally Preferable Alternative	The alternative that will best promote the national environmental policy as expressed in NEPA section 101 (42 USC 4321). Ordinarily, the environmentally preferable alternative is that which causes the least harm to the biological and physical environment; it also is the alternative which best protects and preserves historic, cultural, and natural resources. In some situations, there may be more than one environmentally preferable alternative (36 CFR 220.3).
Ephemeral Stream	Streams that flow only as the direct result of rainfall or snowmelt. They have no permanent flow since their streambeds are not connected to groundwater below.
Equivalent Roaded Acres	A standardized unit of measure for land disturbance. A road prism is considered the reference to which other types of land disturbing activities are measured. A road is given an ERA coefficient of 1.0 (1 acre of road is equal to 1.0 ERA). Other disturbances such as logging, site preparation and wildfires are equated to a road surface by ERA coefficients that reflect their relative level of contribution to changes in runoff and sediment regimes in the watershed.
Erosion Hazard Rating (EHR)	A rating system used to classify the relative vulnerability of soil to erosion.
Escarpment	A long, more or less continuous cliff or relatively steep slope produced by erosion or by faulting.
Fauna	The animal life of an area.
Fireline	A corridor, which has been cleared of organic material to expose mineral soil. Firelines may be constructed by hand or by mechanical equipment (e.g., dozers).
Fire Return Interval	Number of years between 2 successive fires in a specified area.
Flag and Avoid	The hanging of flagging in order to identify for the purpose of avoidance of a special feature in an area.

Flame Length	The length of flame measured in feet. Increased flame lengths increase resistance to control and likelihood of torching events and crown fires.
Flora	The plant life of an area.
Focal Species	A species of concern.
Forest Cultivation	This treatment immediately follows deep tilling and is designed to uproot competing vegetation. The forest cultivator has multiple ripper shanks spaced on a V-shaped bar that cultivates to an 18-inch depth.
Forest Road or Trail	A road or trail wholly or partly within or adjacent to and serving the National Forest system that the Forest Service determines is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources (36 CFR 212).
Free Flowing River	Existing or flowing in a natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway.
Fuelbreak	A system of linear or mosaic patch treatments of forest or shrub vegetation designed and treated to reduce fire spread, intensity, and create barriers to fire spread.
Fuel Loading	The weight per unit area of fuel, often expressed in tons per acre.
Fuel Moisture	Fuel models are described by the volume of 1-hour, 10-hour, 100-hour, and 1000-hour dead fuels; herbaceous and woody live fuels; and fuel bed depth and moisture of extinction (the fuel moisture content, weighed over all fuel classes at which a fire will cease spreading).
Fuels	Plants and woody vegetation, living and dead that are capable of burning.
Fuels Management	The planned manipulation and/or reduction of living and dead forest fuels for forest management and other land use objectives.
Fuels Treatment	The treatment of fuels that left untreated would otherwise interfere with effective fire management or control. For example, prescribed fire can reduce the amount of fuels that accumulate on the forest floor.
Fuelwood	Wood cut into short lengths for burning in a fireplace, woodstove or fire pit.
Geographic Information Systems (GIS)	A computer system capable of storing, manipulating, analyzing, and displaying geographic information.
Ground Cover	Natural organic and inorganic material that covers the watershed ground surface in sufficient quantity to allow a satisfactory rate of water infiltration to replenish ground water and limit erosion to natural rates. Ground cover usually consists of perennial vegetation, forest floor litter and duff, rock, downed wood, or similar erosion resistant material. Sufficient ground cover is usually 50% or greater, and cover of many forested ground surface areas is 80% or higher.
Habitat	The area where a plant or animal lives and grows under natural conditions.
Habitat Connectivity	The degree to which the landscape facilitates animal movement and other ecological flows.
Habitat Fragmentation	The degree to which a habitat type, specific to a plant or animal species, is interrupted by different, incompatible habitat characteristics or types.
Hand Grub	Using hoes or similar tools to severe the competing vegetation adjacent to seedlings and clearing to bare mineral soil.
Hand Piling	Piling by hand branches, limbs, tops and small boles for burning at a later time.
Hand Release	See Manual Release.
Hazard Tree	A standing tree that presents a hazard to people due to conditions such as deterioration of or damage to the root system, trunk, stem, or limbs or the direction or lean of the tree. Synonymous with danger tree for purposes of this project.
Herbaceous	A vascular plant having little or no woody tissue. This commonly refers to grass and grasslike plants.
Heritage Program	The comprehensive Forest Service program of responsibilities with regard to historic preservation. A pro-active program to manage prehistoric and historic cultural resources and cultural traditions for the benefit of the public through preservation, public use, and research.

Home Range Core Area (HRCA)	An area designed to encompass the best available spotted owl habitat, and is in the closest proximity to owl protected activity centers where the most concentrated owl foraging activity is likely to occur.
Hydrologically Connected Segment (HCS)	Locations where drainage off a road or trail is likely to enter a watercourse.
Hydrophobic Soils	Soils that repel water, causing water to collect on the soil surface rather than infiltrate into the ground. Wild fires generally cause soils to be hydrophobic temporarily, which increases water repellency, surface runoff and erosion in post-burn sites.
Image	A graphic representation of a person or thing, typically produced by an electronic device. Common examples include remotely sensed data and photographs.
Indigenous	Any species of plant or animals native to a given land or water area by natural occurrence.
Individuals, Clumps and Openings	An array of tree spatial patterns (or structures) that can be categorized into three primary components: individual trees, tree clumps and openings
Interdisciplinary Team (IDT)	A diverse group of professional resource specialists who propose management strategies and activities to meet Forest objectives and who analyze the effects of these proposals on natural and other resources. Through interaction, participants bring different points of view and a broader range of expertise.
Intermittent Stream	A stream that flows during the wet season due to precipitation runoff and has streamflow extending partially through the dry season due to at least some groundwater contribution.
Invasive Species	Refer to Noxious Weeds for the purposes of this project.
Inventoried Roadless Area	Areas identified in a set of inventoried roadless area maps, contained in Forest Service Roadless Area Conservation, Final Environmental Impact Statement, Volume 2, dated November 2000, which are held at the National headquarters office of the Forest Service, or any subsequent update or revision of those maps.
Irretrievable	A term that applies to the loss of production, harvest, or use of natural resources. For example, some or all of the timber production from an area is lost irretrievably while an area is serving as a winter sports site. The production lost is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume timber production.
Irreversible	A term that describes the loss of future options. Applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity that are renewable only over long periods of time
Jackpot Burning	The prescribed burning of heavy concentrations of down woody fuels.
Lahars	Landslide or mudflow material of pyroclastic (hot ash or tephra) on the flank of a volcano or the deposit formed by such a landslide or mudflow.
Landing	A forested opening, cleared of vegetation, leveled and graded, and used to stockpile sawlogs for eventual loading of load log trucks for haul to a sawmill.
Landscape	A large land area composed of interacting ecosystems that are repeated due to factors such as geology, soils, climate, and human impacts.
Large Woody Debris	Large Woody Debris (LWD) is typically greater than 12 inches in diameter at the midpoint and at least 10 feet in length and refers to large logs on the forest floor or in stream areas. LWD provides wildlife habitat and soil building processes on land, and can provide aquatic habitat complexity and stream stability. Large woody debris is important habitat for a variety of wildlife species and their prey.
Late Forest Succession	The stage of forest succession in which most of the trees are mature or over mature.
Legacy Watershed Effects	Impacts to natural features in a watershed that originated in the distant past but presently remain evident. Impacts may have occurred from land uses prior to establishment of the national forest, forest management activities or natural events such as fires, floods and landslides.
LiDAR	A remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth.
Limited Operating Period (LOP)	A specified period of time during which certain land management activities are prohibited.

Long-Term Risk	A risk to be experienced within the next 50 to 100 years.
Machine Piling	The use of mechanical equipment to push brush skeletons, small dead trees and excess downed fuels into piles for burning.
Maintenance	The upkeep of the entire forest transportation facility including surface and shoulders, parking and side areas, structures, and such traffic-control devices as are necessary for its safe and efficient utilization (36 CFR 212).
Maintenance Level	Defines the level of service provided by, and maintenance required for, a specific road, consistent with road management objectives and maintenance criteria.
Management Action	Any activity undertaken as part of the administration of the National Forest.
Management Requirements	Mandatory components of each alternative designed to implement the Forest Plan and to minimize or avoid potential adverse impacts.
Manual Release	Removing vegetative competition without the use of herbicides or mechanical equipment.
Mastication	Shredding of brush and small trees (live and/or dead) to reduce contiguous fuels and remove competing vegetation and inter-tree competition.
Meadow	Meadows are an ecosystem type dominated by herbaceous plants due to support of shallow groundwater that limits establishment of shrubs or trees. Meadows are usually comparatively flat in relation to their surrounding landscape.
Mesic	Moderately moist climates or environments. Mesic Vegetation generally refers to vegetation found in moist environments. Mesic Soil refers specifically to soils with mean annual temperatures of 8 to 15 degrees centigrade.
Metasedimentary Rock	Rock formed over a long period of time from marine sediments under heat and great pressure.
Mitigation	Avoiding an impact by not taking a certain action or parts of an action. Minimizing impacts by limiting the degree or magnitude of the action. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
Mixed Severity Fire	A wildfire that has a wide range of burn severity. Usually includes high, moderate and low soil burn severity and multiple classes of vegetation burn severity.
Montane Hardwood Forests	Vegetation communities dominated by California black oak, canyon live oak, Pacific madrone or tanoak, for the purposes of this project.
Mosaic	Areas with a variety of plant communities over a landscape. For example, areas with trees and areas without trees occurring over a landscape.
Multiple Use	The management of all the various renewable surface resources of the National Forests so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output. (Multiple-Use Sustained-Yield Act; Public Law 86–517)
Multiplier	The concept in regional economic analysis describing how economic impacts that are directly caused by an action generally create additional economic impacts through indirect or induced mechanisms. The multiplier is the ratio of all economic impacts combined (through direct, indirect and induced mechanisms) divided by just the direct economic impacts.
Mycorrhizal Fungi	A type of fungi which forms a symbiotic relationship with vascular plants for the purpose of exchanging nutrients and moisture by growing amongst the roots of the plants.

National Environmental Policy Act (NEPA)	Codifies the national policy of encouraging harmony between humans and the environment by promoting efforts to prevent or eliminate damage to the environment, thereby enriching our understanding of ecological systems and natural resources. It declares the federal government to be responsible for: (a) coordinating programs and plans regarding environmental protection; (b) using an interdisciplinary approach to decision-making; (c) developing methods to ensure that non-quantifiable amenity values are included economic analyses; and (d) including in every recommendation, report on proposals for legislation, or other major federal actions significantly affecting the quality of the environment a detailed environmental impact statement (EIS).
National Forest System	As defined in the Forest Rangeland Renewable Resources Planning Act, the "National Forest System" includes all National Forest lands reserved or withdrawn from the public domain of the United States, all National Forest lands acquired through purchase, exchange, donation, or other means, the National Grasslands, and land utilization projects administered under title III of the Bankhead-Jones Farm Tennant Act (50 Stat. 525, 7 U.S.C. 1010-1012), and other lands, waters or interests therein which are administered by the Forest Service or are designated for administration through the Forest Service as a part of the system (36 CFR 212).
Natural Resource	A feature of the natural environment that is of value in serving human needs.
Natural Regeneration	Seedlings that germinate and grow on site from seed produced by a mature tree(s) in that location, without human intervention.
Natural Succession	The natural replacement, in time, of one plant community with another. Conditions of the prior plant community (or successional stage) create conditions that are favorable for the establishment of the next stage.
NOAEL	No observable adverse effect level is the toxicity threshold adopted by the Forest Service representing values based on longer-term studies of organisms exposed to low concentrations of chemicals to determine whether there are physiological or generational effects.
NOEC	No observable effect concentration is the toxicity threshold adopted by the Forest Service representing values based on acute exposure of chemicals to organisms.
Noxious Weeds	Any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment.
Old Forest (Old Growth)	Areas that contain large, old trees relative to the species-specific, environmentally-constrained growth capacity of the site.
Outstanding Remarkable Value	A river-related value must be a unique, rare, or exemplary feature that is significant at a comparative regional or national scale.
Paleoecological	The study of ancient or prehistoric ecosystems.
Patch	An area of vegetation, similar in structure and composition.
Perennial Stream	A stream typically with running water on a year-round basis due to precipitation runoff in the wet season and continual contribution of groundwater to support streamflow throughout the dry season except in smaller streams during droughts.
Plantation	A group of trees that have been planted together in a defined area.
Polygon	Used in a GIS to represent an area, a polygon is a digital feature class defined by arcs, or lines, that make up its boundary. A polygon would be used to represent areas such as lakes and land parcels on a map.
Preferred Alternative	The alternative(s) which the Agency believes would best fulfill the purpose and need for the proposal, consistent with the Agency's statutory mission and responsibilities, giving consideration to environmental, social, economic, and other factors and disclosed in an EIS.
Prescribed Fire or Burn	A type of fuel treatment whereby fire is intentionally set in wildland fuels under prescribed conditions and circumstances.
Present Net Benefit	Future positive values discounted back to the present using an annual discount rate of 1.4% for cash flows that occur 30 or more years into the future.
Present Net Cost	The cost factors for treatments discounted back to the present using federally specified discount rates for economic analysis considered in calendar year 2015. The effects of future inflation have been taken out by using constant 2015 dollars.

Present Net Value	The single best estimate of the economic efficiency is the sum of Present Net Cost and Present Net Benefit.
Proposed Action	A proposal made by the Forest Service to authorize, recommend, or implement an action to meet a specific purpose and need.
Protected Activity Centers (PACs)	Designated areas that are afforded protection to specific species by restricting certain management activities. For example, California spotted owl PACs protect owl habitat and breeding areas by restricting timber harvest.
Public Involvement	Using scoping to inform the public, obtain early and continuing public participation, and consider the views of interested parties in planning and decision-making.
Public Land	Land for which title and control rests with a federal, state, regional, county, or municipal government.
Radio Telemetry	The science and technology of automatic measurement and transmission of data by radio from remote sources to receiving stations for recording and analysis. Radio telemetry is used to track the movements of wild animals that have been tagged with radio transmitters.
Reasonably Foreseeable Future Actions	Those Federal or non-Federal activities not yet undertaken, for which there are existing decisions, funding, or identified proposals. Identified proposals for Forest Service actions are described in 220.4(a) (1) (36 CFR 220.3).
Record of Decision (ROD)	A concise public record of the responsible official's decision to implement an action when an environmental impact statement (EIS) has been prepared.
Reforestation	The natural or intentional restocking of existing forests and woodlands that have been depleted.
Regeneration	Tree seedlings and saplings that have the potential to develop into mature forest trees.
Release	Removing the competing vegetation adjacent to planted conifer seedlings. This could involve manual, mechanical, or chemical treatments.
Remote Sensing	Acquiring information about a geographic feature without contacting it physically. Methods include aerial photography and satellite imaging.
Resistance to Control	A measure of the production rate of a resource to construct and hold a fire line. Several factors affect resistance to fire control such as the: type of fuel, volume of fuel to construct line through, fire intensity adjacent to the line, slope, etc.
Resilience	The ability of an ecosystem to maintain diversity, integrity, and ecological processes following a disturbance.
Responsible Official	The Agency employee who has the authority to make and implement a decision on a proposed action (36 CFR 220.3).
Riparian Area	The area along a watercourse, around a lake or pond, or in other wetlands.
Riparian Conservation Area (RCA)	Identified areas within a certain distance from streams, special aquatic features or riparian vegetation. RCA width and protection measures are determined through project level analysis.
Riparian Ecosystem	The ecosystem around or next to water or in wetlands that support unique vegetation and animal communities as a result of a high water table.
Riparian Obligate Vegetation	Trees, shrubs and herbaceous plants that are sustained by wetland conditions along stream courses and in and around meadows and other wetlands. Trees and shrubs are usually deciduous species such as alder, aspen, big leaf maple, and cottonwoods. Shrubs include willows and dogwoods. Herbaceous plants include sedges, rushes and other grasslike plants.
Road	A motor vehicle route over 50 inches wide, unless identified and managed as a trail (36 CFR 212).
Road Density	The length of roads within a given area, most often calculated as miles of road per square mile of land area. Road density is often used as an indicator of watershed disturbance.
Roadless Area	Refer to Inventoried Roadless Area for the purposes of this project.
Salvage Logging	Dead conifer trees cut down and transported to a mill for processing. Logging systems may include ground based equipment such as harvesters and rubber tired skidders, or helicopter logging or skyline systems on steeper slopes and where necessary to meet resource objectives.

Schedule of Proposed Actions (SOPA)	A Forest Service document that informs the public about those proposed and ongoing Forest Service actions for which a record of decision, decision notice or decision memo would be or has been prepared. The SOPA also identifies a contact for additional information on any proposed actions (36 CFR 220.3).
Scope	The range of actions, alternatives and impacts to be considered in an environmental impact statement (40 CFR 1508.25).
Scoping	An early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).
Sensitive Species	Plant or animal species which are susceptible to habitat changes or impacts from management activities. The official designation is made by the USDA Forest Service at the regional level and is not part of the designation of threatened or endangered species made by the U.S. Fish And Wildlife Service.
Seral Stage	The stage of succession of a plant or animal community that is transitional. If left alone, the seral stage will give way to another plant or animal community that represents a further stage of succession.
Shaded Fuelbreak	A defensible location where fuels have been modified, that can be used by fire suppression resources to suppress oncoming wildfires.
Short-Term Risk	A risk to be experienced within the next 10 to 15 years. For example, prescribed burns can disturb habitat in the short-term, but in the long-term the fire resiliency of the habitat may be improved.
Silvicultural System	The cultivation of forests; the result is a forest of a distinct form. Silvicultural systems are classified according to harvest and regeneration methods and the type of forest that results.
Silviculture	The art and science that promotes the growth of single trees and the forest as a biological unit.
Site Preparation	Treatments that prepare the planting area by removing excess fuels and/or de-compacting soil and/or reducing competing vegetation to ensure initial seedling survival.
Skidding	Dragging a log with a tractor to a landing for loading onto a logging truck.
Slash	Tree tops and branches left on the ground after logging or accumulating as a result of natural processes.
Snag	A standing dead tree. Snags are important as habitat for a variety of wildlife species and their prey.
Soil Burn Severity	The effect of a fire on ground surface characteristics, described in terms of char depth, organic matter loss, altered color and structure of soil, and reduced infiltration. Soil burn severity is measured in high, moderate and low classes based upon the degree of effects.
Soil Compaction	An increase in soil density resulting from repeated tracking by mechanized equipment. Compaction reduces infiltration of water and can cause subsequent erosion, and can adversely affect forest vegetation in compacted areas.
Soil Displacement	A lateral relocation of topsoil and often subsoil by movement of mechanized equipment or from sawlog yarding practices. Displacement can result in soil berms or ditches that divert water and lead to erosion.
Soil Organic Matter	Organic matter that is a component of mineral soil horizons (mainly A horizons).
Spatial Data	Represents digitized geographic features associated with real-world locations.
Special Aquatic Features	Lakes, ponds, vernal pools, meadows, bogs, fens, springs, and other wetlands.
Species	A class of individuals having common attributes and designated by a common name; a category of biological classification ranking immediately below the genus or subgenus; comprising related organisms or populations potentially capable of interbreeding.
Strategic Fire Management Area (SFMA)	Fuel reduction areas designed to interrupt fire progression such that the fire reduces in intensity and becomes a surface fire. SFMAs serve to break up the continuity of the vegetation across the landscape and create mosaic patterns. The overall pattern impedes fire spread.

Strategic Fire Management Feature (SFMF)	Over the last few decades, SFMFs had been identified along roads and ridgelines to take advantage of natural or topographic features and established roadways. In addition to fire behavior modification, SFMFs create safe travel route options for emergency access and egress.
Stand	A group of trees that occupies a specific area and is similar in species, age and condition.
Standards and Guidelines (S&Gs)	The primary instructions for land managers. Standards address mandatory actions, while guidelines are recommended actions necessary to a land management decision.
Stand Density Index (SDI)	A measure of the stocking of a stand of trees based on the number of trees per unit area and diameter at breast height of the tree of average basal area. An expression of relative stand density, independent of both stand age and site quality that provides a basis from which to understand the competitive interactions between individual trees.
Stand-Replacing Fire	A fire that burns with sufficient intensity to kill the majority of living vegetation over a given area (grass and brush fires are stand replacement fires for that vegetation type, in forest vegetation types when 75-80% of the stand is killed by fire are also considered stand replacement fires).
Stewardship	Caring for the land and its resources in order to pass healthy ecosystems on to future generations.
Suitability	The appropriateness of certain resource management to an area of land. Suitability can be determined by environmental and economic analysis of management practices.
Surface Organic Matter	Organic material on top of the mineral soil surface, including coarse woody debris (CWD), fine wood, and forest floor layers (O soil horizon).
Sustainability	The ability of an ecosystem to maintain ecological processes and functions, biological diversity, and productivity over time.
Sustainable	The yield of a natural resource that can be produced continually at a given intensity of management is said to be sustainable. Recreation activities are sustainable if the human activity does not reduce ecologic sustainability.
Taxa	Name applied to any one group or entity in the scientific classification system.
Temporary Road	A road necessary for emergency operations or authorized by contract, permit, lease, or other written authorization that is not a forest road or a forest trail and that is not included in a forest transportation atlas.
Thermic	A soil with a mean annual soil temperature of greater than or equal to 15 degrees centigrade, but less than 22 degrees centigrade and a difference between the mean summer and winter soil temperatures of greater than 5 degrees centigrade measured at 50 cm below the surface.
Threatened Species	Those plant or animal species likely to become endangered throughout all or a specific portion of their range within the foreseeable future as designated by the U.S. Fish and Wildlife Service under the Endangered Species Act of 1973.
Threshold of Concern	The level of watershed disturbance which, if exceeded, could create adverse watershed or water quality effects, in spite of application of best management practices and project design criteria.
Understory	The trees and woody shrubs growing beneath branches and foliage formed collectively by the upper portions of adjacent trees.
Unroaded Area	Any area, without the presence of a classified road, of a size and configuration sufficient to protect the inherent characteristics associated with its roadless condition. Unroaded areas do not overlap with inventoried roadless areas.
Variety Class A	A landscape that includes a deep, V-shaped, river-cut canyon through metasedimentary rock providing a variety of rapids, cascades and pools.
Vegetation Burn Severity	The effect of a fire on vegetation, often described by the degree of scorch, consumption, and mortality of vegetation. Vegetation burn severity is measured by classes of canopy mortality or basal area loss.
Visual Quality	The forest visual resources; terrain, geological features, or vegetation.

Water Quality Objectives	Water quality objectives, as listed in the Basin Plan of the California Central Valley Regional Water Quality Control Board, are the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water.
Watershed	An area of land above a given point on a stream that contributes water to the streamflow at that point.
Watershed Sensitive Areas (WSAs)	Portions of watersheds determined to be at high risk of soil erosion and sedimentation due to the combined effects of fire and proposed activities. Criteria for evaluating WSAs include: proposed recovery activities, burn severity, percent slope, slope shape, slope length, existing and potential soil cover, proximity to intermittent and perennial drainages, and proximity to high runoff response soils.
Wetlands	Areas that are inundated by surface or ground water with a frequency sufficient to support (and that under normal circumstances do or would support) a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.
Wild and Scenic River	A river that is either already designated or proposed for designation because of its free flowing condition and outstanding remarkable values.
Wilderness	Undeveloped Federal lands where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain
Wildland	An area in which development is essentially non-existent, except for roads, railroads, powerlines and similar transportation facilities.
Xeric	A soil moisture regime common to Mediterranean climates that have moist cool winters and warm dry summers. A limited amount of water is present but does not occur at optimum periods for plant growth.

D. Human Health and Ecological Risk Assessment

Purpose

The purpose of this analysis is to assess the site-specific risks to human health and ecological risk from using the herbicide glyphosate for the control of grass, bearclover or other competing woody shrubs within the Rim Reforestation planning area on the Stanislaus National Forest, Mi-Wok and Groveland Ranger Districts. The analysis is based on the planned application rates that are proposed for ground-based application (i.e. backpack directed foliar) under alternatives 1, 4 and 5. The application rates are the same for all alternatives. SERA reports and corresponding Worksheets that pertain to Human Health and Ecological Risk for noxious weed treatments using the chemicals aminopyralid, clethodim and clopyralid are available in the project record.

Alternative 1 proposes to manually apply glyphosate herbicide on 16,215 acres for site preparation and 21,300 acres for release. Alternative 1 could apply glyphosate on the 4,031 acres of natural regeneration if needed. Alternatives 1 and 5 would also apply glyphosate to 646 acres of deer habitat enhancement reforestation units. Alternative 4 would apply glyphosate to 88 acres of deer habitat areas for both site preparation and 121 acres for release. Alternative 4 site preparation includes manually applying glyphosate prior to reforestation on 2,867 acres (20% of a subset of units proposed in Alternative 1). Alternative 4 also includes manually applying glyphosate on up to 4,012 acres to maintain a lower brush component in a buffer of 50 feet around Founder Stands to reduce fire spread and increase fire resilience within the planted areas. Alternative 5 has the same proposed reforestation treatment units as Alternative 1; however, areas proposed as natural regeneration in Alternative 1 would be treated as reforestation units in Alternative 5. Alternative 5 would manually apply glyphosate for site preparation on 20,246 acres and release 25,331 acres.

Chemical release may occur up to three times to ensure seedling survival and the established trees are free to grow among the competing vegetation under alternatives 1, 4 and 5. These three alternatives propose the same herbicide treatment and application rate and are close in proximity in space and in time; therefore, they are analyzed together in this risk assessment.

Glyphosate formulations that are labeled for use in and around aquatic environments (e.g. Rodeo or an equivalent) will be used. These liquid formulations consist primarily of a glyphosate salt (i.e. isopropylamine salt) in water (SERA 2011). Surfactant and colorant additives would be used in addition to the glyphosate formulation. Surfactants improve the activity and penetration of the herbicide by reducing surface tension, allowing the herbicide mixture to spread evenly over the surface of vegetation. A colorant is added so that the actual treated area can be readily determined, which helps reduce skips and overlaps as well as human exposures to recently treated vegetation. Backpack sprayers, holding no more than five gallons at one time, would be used to apply the glyphosate mixture for the Reforestation project alternatives.

Table D.01-1 summarizes the proposed number of treatment acres, the expected application rates, and the additives planned for use under the proposed actions and alternatives of each project. The proposed applications would comply with all applicable state and federal regulations, and the label requirements, for the safe use of pesticides. For example, applicators would be adequately trained, medical aid would be available, wash water and eye wash water would be on-site or nearby, and personal protective equipment would be used (e.g. eye protection, gloves, long-sleeved shirt, and long pants). BMPs for pesticide application, including a spill contingency plan, would be implemented.

Table D.01-1 Proposed Application Rates of Glyphosate

ALT	Site Prep (acres)	Release (acres)	Application (acid equivalent)	Additives
1	16,215	21,300	5.0 lbs/acre	Syl-tac™ surfactant (0.4%), Colorfast® Purple or Hi-Lite® Blue dye (0.25%)
2	0	0	0	none
3	0	0	0	none
4	2,867	4,012	5.0 lbs/acre	Syl-tac™ surfactant (0.4%), Colorfast® Purple or Hi-Lite® Blue dye (0.25%)
5	20,246	25,331	5.0 lbs/acre	Syl-tac™ surfactant (0.4%), Colorfast® Purple or Hi-Lite® Blue dye (0.25%)

ALT=Alternative

Direction for Pesticide Use Management and Coordination

FSM 2150 and FSH 2109.14,20 provide direction to provide for pesticide use safety for the public and employees from unsafe work conditions when pesticides are involved. Development of a pesticide risk assessment for reforestation projects is part of this planning process. A pesticide risk assessment does not, in itself, ensure safety in pesticide use. The analysis must be tied to an action plan providing mitigation measures to avoid potential risks identified by the risk assessment.

FSH 2109.14,20 provides direction on the components of a risk analysis, documentation of risk analysis, risk management, risk communication and risk takings.

- Upon completion of a risk analysis, a number of techniques can be used to determine the best course of action for preventing identified problems. These range from taking appropriate mitigation measures to reduce risk, to not taking the proposed action, thus avoiding potential risks.
- Use risk analyses to decide whether, and to what extent, controls on exposure are necessary to protect public health and the environment.
- Managers and decision makers must also recognize the uncertainties associated with risk analyses and incorporate those considerations into their decision making.

Compliance with Direction

Risk assessments for proposed pesticides have been developed for the Forest Service and are incorporated into the pesticide risk assessment for this project. The SERA Human Health and Ecological Risk Assessment and Worksheets that provide the values for rick characterization are available in the project record.

Risk Assessment Overview

This risk assessment examines the potential health effects on all groups of people who might be exposed to glyphosate. Those potentially at risk fall into two groups: workers and members of the public. Workers include applicators, supervisors, and other personnel directly involved in the application of herbicides. The public includes other forest workers, forest visitors, and nearby residents who could be exposed through the drift of herbicide spray droplets, through contact with sprayed vegetation, or by eating, or placing in the mouth, food items or other plant materials, such as berries or shoots growing in or near treated areas, by eating game or fish containing herbicide residues, or by drinking water that contains such residues.

The hazards associated with using glyphosate have been determined through a comprehensive review of available toxicological studies; this review, which is in a risk assessment completed by SERA in March of 2011 under contract with the Forest Service (project record) is incorporated by reference into this site-specific risk assessment.

The analysis of the potential human health effects of the use of glyphosate was accomplished using the methodology generally accepted by the scientific community (NRC 1983, EPA 1986). In essence, this risk assessment consists of comparing doses, based on site-specific herbicide use levels that people might receive from applying the herbicides or from being near an application site with the U.S.EPA's established reference doses (RfD), levels of exposure associated with various margins of safety. Each type of dose, assumed for workers and the public, was compared to the RfD to quantitatively assess the potential level of concern. All calculations were done using FS WorksheetMaker Version 6.00.13, which was developed by SERA. The original EXCEL worksheets (project record) are summarized in this risk assessment.

The outline of this assessment follows a basic 4-step approach recommended by the National Research Council of the National Academy of Sciences (NRC 1983):

1. **Hazard Analysis**. An identification of the hazards associated with glyphosate and its commercial formulations;
2. **Exposure Analysis**. An assessment of potential exposure to the glyphosate;
3. **Dose-Response Assessment**. An assessment of the dose-response relationships;
4. **Risk Characterization**. A characterization of the risks associated with plausible levels of exposure. This section also examines the potential for the proposed treatments to cause synergistic effects, cumulative effects, and effects on sensitive individuals, including women and children.

Unless otherwise specifically referenced, all of the information in the following sections was taken directly from the most recent SERA risk assessment (SERA 2011).

Step 1: Hazard Analysis

Identifying what, if any, effects a compound is likely to have on an exposed population is the first and most critical step in any risk assessment. Unless some plausible biological effect can be demonstrated, the nature of the subsequent dose-response assessment and risk characterization is extremely limited (SERA 2011). A considerable body of information describing the hazards associated with using glyphosate is contained in the risk assessment completed by SERA (2011) under contract to the Forest Service. All of these documents are incorporated by reference into this risk assessment. The following section includes relevant portions of the hazard analysis provided in the most recent SERA risk assessment (SERA 2011).

Mechanism of Action (SERA 2011)

The herbicidal activity of glyphosate is due primarily to the inhibition of a metabolic pathway in plants, known as the shikimate pathway. This metabolic pathway does not occur in humans or other animals; accordingly, this mechanism of action is not directly relevant to humans. The mechanism by which glyphosate exerts toxic effects in humans or experimental mammals is not clear. The symptoms of toxicity in mammals, however, are generally consistent with irritation or damage to mucosal tissue. In addition, glyphosate may interfere with normal metabolic biochemical functions.

Absorption, Distribution, and Excretion (SERA 2011)

In general, glyphosate is not readily absorbed by humans or other mammals under normal conditions. While glyphosate is not rapidly absorbed by the dermal tissue, absorption across abraded skin is much more rapid than absorption across intact skin. If glyphosate is orally administered, it remains in the gastrointestinal tract where it can cause damage to intestinal cells, which could contribute to more rapid absorption after oral exposures. Glyphosate is not extensively metabolized, and more than 95% of administered glyphosate is excreted unchanged. Of the small proportion of glyphosate that is metabolized the most commonly noted metabolite is amino methyl phosphonic acid (AMPA). Differences in metabolic pathways can be an important consideration regarding differences in species sensitivity to some chemical agents. There is no indication that this is an important consideration for glyphosate. Because glyphosate is not extensively metabolized, differences in metabolic pathways are not likely to be an important consideration in extrapolating animal toxicity data to risks in humans.

Acute Oral Toxicity (SERA 2011)

A basic type of acute toxicity information involves time-specific LD50 or LC50 values (i.e. doses or concentrations of a toxicant that result in or are estimated to result in 50% mortality of the test species during a specified exposure or observation period). Most of the LD50 values for glyphosate formulations, as specified on Safety Data Sheets, are non-definitive and indicate that the LD50 values for most formulations are less than 5,000 mg/kg body weight (bw). The preponderance of available data clearly indicates that the mammalian toxicity of glyphosate is low, and very few specific hazards can be identified. Oral doses of technical grade glyphosate that exceed around 300 mg/kg body bw, may cause signs of toxicity, including decreased body weight, changes in certain biochemical parameters in blood as well as tissues, and inhibition of some enzymes (i.e., P450) involved in the metabolism of both endogenous and exogenous compounds. At doses from about 1,000 to 5,000 mg/kg bw, glyphosate can cause death.

Although most studies have been limited to laboratory animals, glyphosate formulations have been used in human suicides and attempted suicides. Of eight case reports of suicidal ingestions of glyphosate formulations, four resulted in mortality with estimated doses ranging from 4,500 to about 17,000 mg formulation/kg bw. In the other four cases, the individuals survived doses estimated to range from about 1,700 to 5,000 mg formulation/kg bw.

Subchronic or Chronic Systemic Toxic Effects (SERA 2011)

Subchronic and chronic toxicity of glyphosate has been well characterized in laboratory mammals. Decreased body weight is one of the more consistent signs of subchronic or chronic exposure. Other general signs of toxicity that have been reported are changes in liver weight, blood chemistry that would suggest mild liver toxicity, or liver pathology. Signs of kidney toxicity, which might be expected based on the acute toxicity of glyphosate, have not been reported consistently and are not severe. As summarized by the National Toxicology Program (NTP), various hematological changes have been observed but are not considered severe and are attributed to mild dehydration.

Effects on Nervous System (SERA 2011)

The neurotoxicity of glyphosate has been tested for in several cases involving laboratory animals as well as numerous case studies involving human suicide, attempted suicide, and non-suicidal exposures. The weight of evidence suggests that any neurologic symptoms associated with glyphosate exposures are secondary to other toxic effects.

Effects on Immune System (SERA 2011)

Methods for assessing chemical exposure on immune responses include assays of antibody-antigen reactions, changes in the activity of specific types of lymphoid cells, and assessments of changes in the susceptibility of exposed animals to resist infection from pathogens or proliferation of tumor cells. No subchronic and chronic toxicity studies on technical grade glyphosate and glyphosate formulations have reported morphological abnormalities in tissues indicative of an effect on the immune system. Similarly, an *in vitro* study using human natural killer cells or cytotoxic T cells revealed no adverse effect on the function of these immune cells at concentrations ranging from 0.01 to 10 μM (i.e. ≈1.7 μg/L or 1.7 mg/L).

Experimental, clinical, and field studies have evaluated the ability of glyphosate formulations to induce allergic responses in humans. Skin rashes following dermal exposures to glyphosate formulations were reported, these effects are thought to derive primarily from irritation rather than allergy. The only other data involving human exposure to glyphosate is an observed increase in leukocyte counts in severely poisoned individuals that committed suicide. The increase in leukocytes, however, is believed to have been associated with secondary effects including damage to the gastrointestinal tract.

Endocrine Effects (SERA 2011)

Assessment of the direct effects of chemicals on endocrine function are most often based on mechanistic studies on estrogen, androgen, or thyroid hormone systems. *In vitro* tests suggest that glyphosate does not exhibit estrogenic activity. Glyphosate has been shown to inhibit androgen receptor binding over a concentration range from about 500 to 3,000 mg a.e./L, but the inhibition was not concentration related. Some tests involving glyphosate formulations have evidenced inhibition of hormone binding estrogen and androgen receptors, but this appears to be more closely related to other ingredients, presumably surfactants, in the formulations and not glyphosate, and in these studies there is an absence of concentration-dependent patterns. In the only study that evaluated the potential effect of glyphosate on estrogen-regulated genes, changes in DNA regulation were assayed using a commercial microarray chip for 1,550 genes. Changes (either up or down regulation) were observed in approximately 44% of the genes; however, the concentrations tested are likely not reasonable for cellular exposure (i.e. approx. 2.3 to 230 mg a.e./L). Furthermore, this study has unresolved discrepancies within the report regarding doses.

In June 2015 the US EPA announced the results of a recently completed Tier 1 screening assays on 52 pesticide chemicals, including glyphosate, as part of its Ecdocrine Disruptor Screening Program (EDSP). The Tier 1 screening data are used to determine whether a chemical has the potential to interact with the endocrine system and thus requires more thorough testing. From US EPA's Executive Summary of Tier 1 results for glyphosate: Based on weight of evidence considerations, mammalian or wildlife EDSP Tier 2 testing is not recommended for glyphosate since there was no convincing evidence of potential interaction with the estrogen, androgen or thyroid pathways (EPA 2015).

Reproductive and Developmental Effects (SERA 2011)

The most sensitive endpoint for glyphosate (i.e. the adverse effect occurring at the lowest dose) involves developmental effects; accordingly, the EPA-derived RfDs for glyphosate are based on developmental effects. These adverse developmental effects, which consist primarily of delayed development, occur only at doses causing signs of maternal toxicity (1,000 mg/kg bw/day in rats and 100 to 175 mg/kg bw/day in rabbits). There is no indication that glyphosate causes birth defects.

Reproduction studies involve exposing one or more generations of the test animal to a chemical compound. Three multi-generation studies are available on technical grade glyphosate. Apparently, multi-generation studies have not been conducted on glyphosate formulations or any of the surfactants used in glyphosate. The lack of multi-generation studies on glyphosate formulations and surfactants is a concern. Notwithstanding this concern, several epidemiology studies on human populations involving the use and application of glyphosate formulations are available. None have demonstrated a statistically significant association between exposure and adverse reproductive effects.

In a multi-generation reproduction study in rats, effects on the kidney were observed in male offspring at 30 mg/kg/day but not at 10 mg/kg/day. In this study, however, the historical control indices for tubular lesions varied markedly in male weanling rats. Therefore, it was concluded that the highest dose tested (30 mg/kg/day) had no adverse reproductive effects. In another study using rabbits, developmental toxicity was not observed at maternal doses up to 350 mg/kg/day, but maternal effects were seen at this dose. The maternal NOEL in this study was 175 mg/kg/day; this is the value EPA has used to establish the current RfD.

Several publications in the open literature have suggested that glyphosate or some glyphosate formulations may have adverse effects on the testes and may lead to a reduction in testosterone. Refer to SERA (2011, p. 59-61) for a detailed discussion of these studies. While these studies may impact the perception of risk, they do not have a substantial impact on the hazard identification because concerns for reproductive function are adequately encompassed by the current RfD for glyphosate.

Carcinogenicity and Mutagenicity (SERA 2011)

Demonstrating that a compound is mutagenic is different from demonstrating that a compound is carcinogenic. Although mutagenicity data can be used to evaluate the mechanism by which a potential carcinogen may operate, quantitative risk assessments for carcinogenicity are based on either *in vivo* cancer bioassays in experimental mammals or epidemiology studies that provide adequate measures of both exposure and risk. Based on the available information on glyphosate, the EPA/OPP (1993a) has concluded that glyphosate should be classified as Group E (evidence of non-carcinogenicity for humans).

A few studies have reported mutagenic activity caused by significantly high doses of glyphosate and glyphosate formulations (e.g. 100 times greater than plausible levels glyphosate concentrations in the plasma of rats exposed to a nontoxic dose of 10 mg/kg bw. Increased incidence of chromosomal damage in humans has been observed after aerial applications of glyphosate formulations at rates ranging from 1 to 4 lbs a.e./acre. This does not demonstrate, however, that glyphosate causes hereditable mutations or that increased risks of cancer or any overt signs of toxicity would be expected. Furthermore, the formulations studied in these human exposure cases are not identified for use by the Forest Service and should only be viewed as a worst case assumption.

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 recent decision 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 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. 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.

The USFS human health and ecological risk assessment for glyphosate (SERA 2011), includes a lengthy discussion of the mutagenic and carcinogenic potential of glyphosate including non-Hodgkin’s lymphoma (Section 3.1.10). Many of the key references used in Guyton (2015) and another recent, but more in-depth review (Schinasi and Leon, 2014) are discussed in the glyphosate risk assessment. The USFS risk assessment concludes (page 70):

The nature of the available epidemiology data on glyphosate is addressed in the U.S. EPA/OPP (2002) assessment:

- This type of epidemiologic evaluation does not establish a definitive link to cancer. Furthermore, this information has limitations because it is based solely on unverified recollection of exposure to glyphosate-based herbicides.
- 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 (Section 3.1.10.1), 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.

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'.

Based on standard animal bioassays for carcinogenic activity *in vivo*, there is no basis for asserting that glyphosate is likely to pose a substantial risk of causing cancer. As with any compound that has been studied for a long period of time and tested in a large number of different systems, some equivocal evidence of carcinogenic potential is apparent and may remain a cause of concern, at least in terms of risk perception. 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 EPA Group E classification appears to be reasonable. Therefore, no quantitative risk assessment for cancer is conducted as part of the current analysis.

Effects on the Skin and Eyes (SERA 2011)

Technical grade glyphosate causes only slight skin irritation and is classified as Category IV (the least hazardous category) for this endpoint (EPA/OPP 1993a). Formulations that contain primarily glyphosate and water with no surfactants as well as most formulations with surfactants are classified as either non-irritating or only slightly irritating to skin.

Based on several eye irritation studies submitted to the EPA as part of the registration process, U.S. EPA/OPP (1993b) classifies glyphosate as mildly irritating to the eyes (Category III). Some formulations of glyphosate, however, are classified by the EPA/OPP as corrosive (Category I – corneal opacity not reversible within 7 days) or severe eye irritants (Category II – corneal opacity reversible within 7 days or other eye irritation persisting for 7 days or more). In two studies that surveyed 1,912 calls to poison control involving glyphosate and ocular effects, symptoms included blurred vision, a stinging or burning sensation, and lacrimation. The most severe cases of eye irritation appear to involve accidental exposures in which the glyphosate formulation was sprayed into eyes under pressure. No cases of permanent eye damage were reported.

Inhalation Exposure (SERA 2011)

Glyphosate has a very low vapor pressure and will not tend to volatilize. Biomonitoring studies in workers indicate that inhalation exposure levels for workers applying glyphosate are low relative to the dermal exposure levels. The lowest reported definite LC50 is 1.6 mg formulation/L (i.e. Honcho Plus, a 41% formulation of the IPA salt of glyphosate). Thus, the LC50 of 1.6 mg formulation/L corresponds to about a concentration of 0.4884 mg a.e./L, which is above the highest detected concentration of glyphosate in air during glyphosate applications (i.e. 2.5x10-5 mg a.e./L) by a factor of 20,000.

Impurities and Metabolites (SERA 2011)

The primary metabolite of glyphosate in mammals is amino methyl phosphonic acid (AMPA). In mammals, only very small amounts of AMPA, less than 1% of the absorbed dose, are formed. In general, the common approach to examining the potential importance of the metabolism of a chemical agent by a mammal (i.e. xenobiotics) typically involves toxicology studies and monitoring studies of the parent compound. Thus, in terms of assessing direct exposures to technical grade glyphosate, the inherent exposures to AMPA as a metabolite are encompassed by the existing toxicity data on glyphosate.

In addition, AMPA is an environmental metabolite of glyphosate. This is to say that AMPA is formed in environmental media such as soil and water as a breakdown product of glyphosate. About 20% of applied dose of glyphosate may be found in water as AMPA after about 6 months. The EPA, the World Health Organization, and others have assessed the potential consequences of exposures to AMPA as an environmental metabolite. Based on these reviews, the EPA concluded that only the glyphosate parent is to be regulated and that AMPA is not of toxicological concern regardless of its levels in food. Consequently, in this risk assessment, AMPA is not quantitatively considered in the dose-response and exposure assessments.

Glyphosate also contains N-nitrosoglyphosate (NNG) as an impurity. NNG contains the nitrosoamine group. Certain groups of nitrosoamines have served as model compounds in some of the classical studies on chemical carcinogenicity. Carcinogenicity testing of nitroso contaminants, however, is normally required only in those cases in which the level of nitroso compounds exceeds 1.0 ppm. Analyses have shown that greater than 92% of the individual technical glyphosate samples contain less than 1.0 ppm NNG. Therefore, the NNG content of glyphosate was not toxicologically significant and a detailed dose-response and exposure assessment for NNG does not appear to be warranted.

Step 2: Exposure Analysis

The exposure scenarios considered in a risk assessment involving pesticide exposure are determined by the application method and the chemical and toxicological properties of the compound. Depending on the properties of the chemical and the application method, the risk assessment may consider acute, subchronic, or chronic durations of oral, dermal, inhalation or combined exposure to the pesticide. The SERA FS WorksheetMaker provides a range of assumed values for each of these variables (SERA 2011a). Ranges of absorbed doses are calculated based on ranges of these variables (i.e. central, low, and high) in addition to the proposed application rate and application volume per acre. As discussed earlier in this risk assessment and shown in Table D.01-1, the proposed application rate for the Rim Reforestation project is 5.0 lb a.e./acre and the central, low, and high application volumes were assumed to be 30, 20, and 40 gallons/acre, respectively. The exposure assessment is also based on the assumption that the Rim Reforestation herbicide application units would receive 100% coverage with herbicide; when in fact, treatments would only target specific plants and patches of vegetation. Therefore, the chances of an individual receiving the absorbed doses reported in the following analysis should be viewed as highly conservative.

Worker Exposure

Two types of exposure assessments are considered: general and accidental/incidental. The term general exposure is used to designate exposures involving absorbed dose estimates based on handling a specified amount of chemical during specific types of applications. The accidental/incidental exposure scenarios involve specific events that may occur during any type of application (SERA 2011).

While workers are likely to receive some low-level doses when routinely working with chemicals, standard safety practices and the use of required protective clothing and equipment normally would reduce the actual dose levels below those estimated in the following analysis. Similarly, any general or accidental/incidental exposures that might occur would likely be less than those estimated because the standard protocol, as specified in the herbicide spill plan prepared for projects involving the use of pesticides, would be to wash the chemical off immediately.

GENERAL EXPOSURE (SERA 2011)

General occupational exposures typically encompass multi-route exposures (i.e. oral, dermal, and inhalation); nonetheless, dermal exposure is generally the predominant route for herbicide applicators. The default exposure rate assumed by the SERA FS WorksheetMaker for the type of glyphosate application proposed by the Rim Reforestation project (i.e. backpack directed foliar) is 0.003 mg/kg bw per lb applied with a range of 0.0003 to 0.01 mg/kg bw per lb applied. These values correspond well with values observed during several worker exposure studies, which are discussed in detail by the SERA (2011) glyphosate risk assessment. The estimated absorbed dose for general exposures during backpack application of glyphosate is expressed in mg chemical per kg bw per day (mg/kg/day) and is summarized in Table D.01-2. Details about the assumptions and calculations used in all worker exposure assessments are given in the detailed calculation worksheets in the SERA FS WorksheetMaker (Worksheets C01–C03). The rationale for and sources of the specific values used in these exposure scenarios are given in the documentation for the worksheets (SERA 2011a) and in the SERA (2011) glyphosate risk assessment.

Accidental Exposures (SERA 2011)

Accidental exposures are most likely to involve splashing a solution of herbicide into the eyes and may also involve various dermal exposure scenarios. Although quantitative exposure scenarios for ocular exposures are not modeled in the SERA FS WorksheetMaker, or developed in other risk assessments (e.g. SERA 2003 and 2011), ocular exposures to some formulations of glyphosate may cause moderate to severe eye damage, as discussed in the Hazard Analysis section of this risk assessment. This effect is considered qualitatively in the Risk Characterization section for workers later in this risk assessment.

Two types of accidental dermal exposure scenarios are considered in this risk assessment. They involve direct contact with a pesticide solution and accidental spills of the pesticide onto the surface of the skin. In addition, two exposure scenarios are developed for each of the two types of dermal exposure, and the estimated absorbed dose for each scenario is expressed in units of mg chemical per kg bw per event (mg/kg/event). Both sets of exposure scenarios are summarized in Table D.01-2.

Table D.01-2 Worker Exposure from Backpack Application of Glyphosate

Scenario	Central AD[1]	Lower AD[1]	Upper AD[1]
General Exposures			
Backpack Application	0.03003	0.0018	0.2
Accidental/Incidental Exposures			
Contaminated Gloves, 1 minute	0.000006	0.00000111	0.0000378
Contaminated Gloves, 1 hour	0.00036	0.0000666	0.002268
Spill on Hands, 1 hour	0.000787039	0.000187188	0.00287856
Spill on lower legs, 1 hour	0.001939488	0.000461284	0.007093595

AD=Absorbed Dose (mg/kg/day or mg/kg/event)
[1] Milligrams of agent per kilogram of body weight per day or per event with Glyphosate applied at a rate of 5.0 pounds acid equivalent/acre.
Source: SERA FS WorksheetMaker, Worksheet C01,E01.

The two direct contact scenarios consider a worker that wears grossly contaminated gloves for 1 minute and for 1 hour. These contact scenarios assume that wearing grossly contaminated gloves is equivalent to immersing the hands in a solution. The exposure scenarios involving chemical spills onto the skin are characterized by a spill on to the lower legs as well as a spill on to the hands and are based on the assumption that a certain amount of the chemical adheres to the skin. The absorbed dose is then calculated as the product of the amount of chemical on the surface of the skin. Both of the spill scenarios assume that the worker waits 1 hour before washing the chemical off.

General Public Exposure

Under normal circumstances, members of the general public should not be exposed to substantial levels of glyphosate as a result of Forest Service activities. Members of the public would generally not be in the areas of maintenance work during herbicide application. Application sites would be inspected prior to herbicide application to ensure that no people are present, and signs would be posted that state the name of the chemicals applied and date of application. Signs would be posted at each application site for at least 30 days after application. In addition, all application activities would stop temporarily if a member of the public entered the vicinity of the application site.

Table D.01-3 General Public Exposure from Backpack Application of Glyphosate

Scenario	Receptor	Central AD[1]	Lower AD[1]	Upper AD[1]
Accidental Acute Exposures (mg/kg/event)				
Direct Spray of Child, whole body	Child	2.97E-02	7.07E-03	1.09E-01
Direct Spray of Woman, feet and lower legs	Adult Female	2.99E-03	7.10E-04	1.09E-02
Water consumption (spill)	Child	5.69E-01	5.21E-02	2.56E+00
Fish consumption (spill)	Adult Male	6.49E-03	9.74E-04	1.95E-02
Fish consumption (spill)	Subsistence Populations	3.16E-02	4.75E-03	9.49E-02
Non-Accidental Acute Exposures (mg/kg/event)				
Vegetation Contact, shorts and T-shirt	Adult Female	5.96E-03	1.89E-03	1.44E-02
Contaminated Fruit	Adult Female	5.88E-02	2.69E-02	9.33E-01
Contaminated Vegetation	Adult Female	8.10E-01	5.63E-02	6.75E+00
Swimming, one hour	Adult Female	2.18E-08	6.35E-10	6.90E-07
Water consumption	Child	4.14E-03	2.98E-04	4.68E-02
Fish consumption	Adult Male	4.72E-05	5.58E-06	3.56E-04
Fish consumption	Subsistence Populations	2.30E-04	2.72E-05	1.73E-03
Chronic/Longer Term Exposures (mg/kg/day)				
Contaminated Fruit	Adult Female	9.41E-03	4.30E-03	1.49E-01
Contaminated Vegetation	Adult Female	1.30E-01	9.00E-03	1.08E+00
Water consumption	Adult Male	2.71E-05	8.80E-06	9.94E-04
Fish consumption	Adult Male	5.16E-08	2.39E-08	1.57E-06
Fish consumption	Subsistence Populations	4.18E-07	1.93E-07	1.28E-05

AD=Absorbed Dose (mg/kg/day or mg/kg/event)

[1] Milligrams of agent per kilogram of body weight per day or per event with Glyphosate applied at a rate of 5.0 pounds acid equivalent/acre.

Source: SERA FS WorksheetMaker, Worksheet E03.

Despite the precautionary actions taken during application, the chances that members of the general public will be exposed to glyphosate in Forest Service applications are highly unpredictable. The proposed Rim Reforestation application units are within or near areas used for various purposes by the public, such as fishing, camping, hunting, woodcutting and off-highway motor vehicle travel. Given this uncertainty, a highly conservative approach for estimating exposure rates for the general public is used in this risk assessment. Exposure assessments developed in this risk assessment are based on Extreme Values rather than a single value. Extreme value exposure assessments bracket the most plausible estimate of exposure (referred to statistically as the central or maximum likelihood estimate) with lower and upper bounds of credible exposure levels. This approach is essentially an elaboration on the concept of the Most Exposed Individual (MEI). The MEI approach attempts to characterize the extreme but still plausible upper limit on exposure (SERA 2011).

The exposure scenarios developed for the general public are summarized in Table D.01-3. As with the worker exposure scenarios, details about the assumptions and calculations used in these assessments are given in the detailed calculation worksheets in the SERA FS WorksheetMaker (Worksheets D01–D11). The rationale for and sources of the specific values used in these exposure scenarios are given in the documentation for the worksheets (SERA 2011a) and in the SERA (2011) glyphosate risk assessment.

Table D.01-3 shows the kinds of exposure scenarios developed for the general public include acute accidental, acute non-accidental, and longer-term or chronic exposures. The accidental exposure scenarios assume that an individual is exposed to the compound of concern either during or shortly after its application. As well, the nature of the accidental exposures is intentionally extreme. Non-accidental exposures involve dermal contact with contaminated vegetation as well as the consumption of contaminated fruit, vegetation, water, or fish. The longer-term or chronic exposure scenarios parallel the acute exposure scenarios for the consumption of contaminated fruit, water, or fish.

Step 3: Dose-Response Assessment

Acute RfDs are usually based on developmental studies in which an adverse effect is associated with a single dose of a pesticide. The EPA, however, has not derived an explicit acute RfD for glyphosate. Instead, a chronic RfD that is equivalent to an acute RfD is used to characterize risks associated with both acute and longer-term exposures (EPA/OPP 1993a, 1993c). Three different longer-term RfD values have been derived for glyphosate by the EPA/OPP, EPA Office of Research and Development, and the World Health Organization. The EPA/OPP derived an RfD of 2 mg/kg/day, which is the only chronic RfD for glyphosate based on a study that defines both a NOAEL and a LOAEL (SERA 2011). Consequently, the SERA (2011) glyphosate risk assessment and SERA FS WorksheetMaker (SERA 2011a) adopted the EPA/OPP derived chronic RfD to characterize risks associated with both acute and longer-term exposures.

The study that the EPA/OPP used to determine the 2 mg/kg bw/day RfD used in this risk assessment was conducted on rabbits. Although this study established a NOAEL of 175 mg/kg bw/day and a LOAEL of 350 mg/kg bw/day that does not mean that a dose of 4 mg/kg bw/day is likely to cause mortality in humans. As discussed early in the Hazard Analysis section of this risk assessment, individuals may well survive suicidal ingestions of more than 4,000 mg/kg bw, so long as they receive prompt medical attention (SERA 2011). Furthermore, exposures to doses of more than 2 mg/kg bw of glyphosate are unlikely, as shown in Table D.01-2 and Table D.01-3.

Step 4: Risk Characterization

The quantitative risk characterization is expressed as the hazard quotient (HQ). The HQ is calculated as the estimated doses in units of mg/kg bw for acute exposures or units of mg/kg bw/day for longer-term exposures divided by the RfD of 2 mg/kg bw/day. Because the HQs are based on the RfD, an HQ of 1 or less suggests that exposures are below the level of concern. HQs greater than 1 indicate that the exposure exceeds the level of concern (SERA 2011). All HQs are calculated assuming that the Rim Reforestation herbicide application units would receive 100% coverage with herbicide; when in fact, treatments would only target specific plants and patches of vegetation. Therefore, HQs reported in the following analysis should be viewed as highly conservative.

Workers

A quantitative summary of the risk characterization for workers is presented in Table D.01-4 for the unit application rate of 5.0 lbs a.e./acre. Given the very low HQs, none of the accidental exposure scenarios approach a level of concern. The highest HQ for any accidental exposure scenario is 0.004, the upper bound of the HQ for a pesticide spill over the lower legs that is not effectively mitigated for 1 hour. This HQ is below the level of concern by a factor of 250. Confidence in this assessment is reasonably high because of the availability of dermal absorption data in humans, as presented in the Hazard Analysis section of this risk assessment.

The HQs for general or longer-term exposures in workers are also low. Even at the upper bound of plausible exposures, all HQs are below the level of concern. For an application rate of 5.0 lbs a.e./acre, the highest HQ is 0.1, the upper bound for workers involved in backpack applications. To reach a level of concern or an HQ of 1, would require an application rate of about 50 lbs a.e./acre. Such an application rate far exceeds any plausible application of glyphosate as proposed by the Rim Reforestation project and is considerably higher than even the maximum labeled application rate of about 8 lbs a.e./acre (SERA 2011).

Table D.01-4 Worker Hazard Quotients (Toxicity)

Scenario	Central HQ[1]	Lower HQ[1]	Upper HQ[1]
General Exposures			
Backpack Application	2E-02	9E-04	0.1
Accidental/Incidental Exposures			
Contaminated Gloves, 1 minute	3E-06	6E-07	2E-05
Contaminated Gloves, 1 hour	2E-04	3E-05	1E-03
Spill on Hands, 1 hour	4E-04	9E-05	1E-03
Spill on lower legs, 1 hour	1E-03	2E-04	4E-03

HQ=Hazard Quotient
[1] 2 mg/kg bw/day RfD and a glyphosate application rate with Glyphosate applied at a rate of 5.0 pounds acid equivalent/acre.
Source: SERA FS WorksheetMaker, Worksheet E02.

General Public

A quantitative summary of the risk characterization for members of the general public is presented in Table D.01-5. Like the corresponding table for workers, Table D.01-5 is based on a unit application rate of 5.0 lbs a.e./acre. For an application rate of 5.0 lbs a.e./acre, most of the HQs do not exceed a level of concern.

Table D.01-5 Hazard Quotients (Toxicity) for the General Public

Scenario	Receptor	Central HQ[1]	Lower HQ[1]	Upper HG[1]
Accidental Acute Exposures (mg/kg/event)				
Direct Spray of Child, whole body	Child	1E-02	4E-03	5E-02
Direct Spray of Woman, feet and lower legs	Adult Female	1E-03	4E-04	5E-03
Water consumption (spill)	Child	0.3	3E-02	1.3
Fish consumption (spill)	Adult Male	3E-03	5E-04	1E-02
Fish consumption (spill)	Subsistence Populations	2E-02	2E-03	5E-02
Non-Accidental Acute Exposures (mg/kg/event)				
Vegetation Contact, shorts and T-shirt	Adult Female	3E-03	9E-04	7E-03
Contaminated Fruit	Adult Female	3E-02	1E-02	0.5
Contaminated Vegetation	Adult Female	0.4	3E-02	3
Swimming, one hour	Adult Female	1E-08	3E-10	3E-07
Water consumption	Child	2E-03	1E-04	2E-02
Fish consumption	Adult Male	2E-05	3E-06	2E-04
Fish consumption	Subsistence Populations	1E-04	1E-05	9E-04
Chronic/Longer Term Exposures (mg/kg/day)				
Contaminated Fruit	Adult Female	5E-03	2E-03	7E-02
Contaminated Vegetation	Adult Female	6E-02	4E-03	0.5
Water consumption	Adult Male	1E-05	4E-06	5E-04
Fish consumption	Adult Male	3E-08	1E-08	8E-07
Fish consumption	Subsistence Populations	2E-07	1E-07	6E-06

HQ=Hazard Quotient
[1] 2 mg/kg bw/day RfD and a glyphosate application rate with Glyphosate applied at a rate of 5.0 pounds acid equivalent/acre.
Source: SERA FS WorksheetMaker, Worksheet E04.

Table D.01-5 shows the highest HQ for accidental acute exposures is for a child's consumption of contaminated water after an accidental spill. The upper bound of the HQ for this exposure scenario (1.3) slightly exceeds the level of concern. The risk characterization for this upper bound assumes that a field solution of 200 gallons are spilled with no dilution or decomposition of herbicide into a 1 meter deep pond with a surface area of 1,000 m2, and then a 13.3 kg child drinks 1.5 L of the pond water (SERA FS WorksheetMaker, Worksheets B04b and D05). The potential for a spill of herbicides into a waterbody is mitigated through designating routes of travel and mixing sites, minimizing herbicide mix in tanks while traveling between units, requiring a separate water truck from the batch truck, and if a spill occurs, outlining responses required by the contractor.

Table D.01-5 shows the greatest concern of both the non-accidental exposure scenarios and the chronic/longer-term exposure scenarios involves the consumption of contaminated vegetation by an adult female. The HQ for the upper bound for the acute exposure is 3.0 (exceeds a HQ of 1.0) and the HQ for the upper bound for the chronic exposure is 0.5. At typical and lower levels of exposure, this scenario yields HQs below a level of concern. For contaminated vegetation, the maximum labeled application rate of about 5 lbs a.e./acre (SERA 2011) would result in a HQ value of about 5.6 with a corresponding dose of about 10.8 mg/kg bw, which is much higher than values estimated in this risk assessment. There is no basis for asserting that a dose as high as 10.8 mg/kg bw would lead to gross signs of toxicity. As discussed in the Dose-Response Assessment section, lethal doses would not be expected at this dose. Nonetheless, adverse effects observed in pregnant rabbits at a dose of 350 mg/kg bw (i.e. a factor of 2 above the NOAEL on which the RfD is based) do raise concerns for adverse health effects in sensitive individuals, such as pregnant women (SERA 2011).

The proposed Rim Reforestation project herbicide application units are not areas known to be commonly used by local Native Americans or the general public to gather plant materials. It is plausible, however, that people would occasionally target these locations for gathering plant materials. Edible plant species, such as miner's lettuce (Montia perfoliata), are known to occur in or near the proposed herbicide application units. As discussed previously, however, precautions would be taken to increase public awareness of herbicide use by posting signs for 30 days following applications. Colorants would also be added to the glyphosate mixture, which would decrease the likelihood of people gathering and consuming contaminated vegetation. In most instances, particularly for longer-term scenarios, treated vegetation would probably show signs of damage from exposure, rendering it undesirable for consumption. Furthermore, all HQs are calculated assuming 100% coverage of the treatment units; however, treatments will only target specific plants and patches of vegetation. Given these circumstances, it is unlikely that someone would consume enough contaminated vegetation to result in exposure levels similar to those reported in Table D.01-5. These values and all other exposure analyses should be viewed as highly conservative estimates.

Cumulative Effects

Cumulative effects from herbicides may result from additive doses from (1) various routes of exposure from a single treatment (i.e. eating contaminated vegetation and drinking contaminated water), or (2) exposure to multiple herbicide treatments.

In terms of repeated exposure to one particular chemical, the analysis of chronic exposure scenarios discussed in this risk analysis specifically addresses the potential long-term cumulative impacts associated with glyphosate. This risk assessment determined that there is a low likelihood of cumulative adverse effects associated with long-term or repeated exposures to the proposed chemicals. Furthermore, since glyphosate persists in the environment for a relatively short time (generally less than 1 year), does not bioaccumulate, and is rapidly eliminated from the body, doses from re-treatments in subsequent years are not expected to have additive effects.

The most plausible situation that would result in additive doses would result from various routes of exposure from the Rim Reforestation project. Although each of the HQs summarized in Table D.01-4 and Table D.01-5 involves a single exposure scenario, additive doses from multiple sources of exposure are inconsequential for glyphosate (SERA 2011). The only substantial exposure scenario involves the consumption of contaminated vegetation. All other plausible combinations of exposures would not have a substantial impact on the risk characterization. Furthermore, this risk assessment specifically considers the effect of repeated exposure in that the chronic RfD is used as an index of acceptable exposure. Consequently, repeated exposure to levels below the toxic threshold should not be associated with cumulative toxic effects.

Application of different types of herbicides has occurred on private land within a few miles of the Rim Reforestation herbicide application units sometime within the last three years and could continue for the next five years; however, the exact location, year, type and quantity being applied by private landowners is unknown. Therefore, potential additive doses could occur between the Rim Reforestation project and foreseeable future herbicide applications on private land. Rim Reforestation herbicide treatments would likely start in the spring of 2017 with subsequent treatments occurring for up to 15 years, with less intense applications in subsequent years as the density of targeted vegetation decreases. Private land applications are expected to conclude by 2020. Therefore, pesticide application on private lands in the same year as the Rim Reforestation treatments would result in the worst case scenario for cumulative effects. As previously discussed, the only substantial exposure scenario involves the consumption of contaminated vegetation. Precautionary measures that would be implemented (e.g. signs and colorants) to decrease the likelihood of people gathering and consuming contaminated vegetation, and in most instances treated vegetation would probably show signs of damage from exposure, rendering it undesirable for consumption. Furthermore, all HQs were calculated assuming 100% coverage of the treatment units; when in fact, treatments would only target specific plants and patches of vegetation leaving up to 20% of the vegetation within a unit untouched. Given these circumstances, it is unlikely that someone would consume enough contaminated vegetation from multiple herbicide application units to result in gross toxicity. Therefore, potential future cumulative effects would not be significant.

In summary, cumulative effects from the proposed application of glyphosate under all proposed alternatives of the Rim Reforestation project would be insignificant.

Inert Ingredients

The approach used in the SERA Risk Assessments, and this site-specific analysis to assess the human health effects of inert ingredients and full formulations has been to: 1) compare acute toxicity data between the formulated products (including inert ingredients) and their active ingredients alone; 2) disclose whether or not the formulated products have undergone chronic toxicity testing; and 3) identify, with the help of EPA and the chemical companies, ingredients of known toxicological concern in the formulated products and assess the risks of those ingredients.

Although the biological endpoints between acute and chronic toxicity differ, relationships do exist. Therefore, acute toxicity data can be used to give an indication of overall toxicity. The court in NCAP v. Lyng, 844 F.2d 598 (9th Cir 1988) decided that this method of analysis provided sufficient information for a decision maker to make a reasoned decision. In SRCC v. Robertson, Civ. No. S-91-217 (E.D. Cal., June 12, 1992), and again in CATS v. Dombeck, Civ. S-00-2016 (E.D. Cal., Aug 31, 2001), the district court upheld the adequacy of the methodology used in USDA (1989) for disclosure of inert ingredients and additives.

The EPA categorized approximately 1,200 inert ingredients into four lists. Lists 1 and 2 contain inert ingredients of toxicological concern. List 3 includes substances for which EPA has insufficient information to classify as either hazardous (List 1 or 2) or non-toxic (List 4). List 4 contains non-toxic substances such as corn oil, honey and water. Use of formulations containing inert ingredients on List 3 and 4 is preferred on vegetation management projects under current Forest Service policy.

Since most information about inert ingredients is classified as "Confidential Business Information" the Forest Service asked EPA to review 13 herbicides (including glyphosate) and the commercial formulations and advise if they contain inert ingredients of toxicological concern. The EPA determined that there were no inerts on List 1 or 2. While these formulated products have not undergone chronic toxicity testing like their active ingredients, the acute toxicity comparisons, the EPA review, and our examination of toxicity information on the inert ingredients in glyphosate leads to the conclusion that the inert ingredients in these formulations do not significantly increase the risk to human health and safety over the risks identified for the active ingredients.

Additives

None of the additives (i.e. adjuvants) proposed for use contain ingredients found on the EPA's inerts list 1 or 2. The assessment of hazards for these additives is limited by the proprietary nature of the formulations. Unless the EPA classifies a compound in the formulation as hazardous, the manufacturer is not required to disclose its identity. All of the additives discussed here are no more than slightly toxic when ingested, inhaled, or absorbed through the skin (i.e. Acute Toxicity Categories III or IV). Therefore, the primary summary statement that can be made is that the more common risk factors for the use of these additives are through skin or eye exposure. This points to the need for good industrial hygiene practices while utilizing these products, especially when handling the concentrate, such as during mixing. The use of chemical resistant gloves and goggles, especially while mixing, should be observed (USDA 2007c).

Syl-tac™

Syl-tac™ (USDA 2007c) has a "Caution" signal word. It may cause slight skin and eye irritation. It is of low acute oral and dermal toxicity. The oral LD50 is greater than 5 g/kg (Category IV), the dermal LD50 is greater than 5 g/kg (Category III), and the LC50 is greater than 2.07 ml/L (III). Syl-tac™ is a blend of vegetable oils and silicone based surfactants: Hasten® and Sylgard® 309.

HASTEN®

Hasten® (USDA 2003; USDA 2007c; SERA 2011) has a "Caution" signal word. It may be mildly irritating to the skin and to the eyes. The product is of low acute oral and dermal toxicity. The oral LD50 is greater than 5 g/kg (Category IV), the dermal LD50 is greater than 5 g/kg (Category III), and the inhalation LC50 is 5.79 ml/L (Category III). The main ingredient in Hasten® is ethylated corn, canola, and soybean oil (a regulated food additive under 21 CFR 172.515). This is combined with sorbitan alkylethoxylate ester as a nonionic surfactant. The polyoxyethylene dialkylester is not sufficiently identified to say anything definite about its composition or toxicity.

Hasten® contains ethoxylated ingredients. Ethoxylates are formed by reactions of ethylene oxide. In the manufacturing process, some unreacted ethylene oxide as well as the contaminant 1, 4-dioxane can become part of the final formulation. Both of these chemicals are considered likely human carcinogens.

The EPA considers dioxane to be a carcinogen, Class B2 (probable human carcinogen). It has a cancer potency factor of 0.011 (mg/kg/day)-1. The upper bound risk is equivalent to a cancer risk of 1 in about 1.5 million.

Based on the estimated levels of exposure and the criteria for acute and chronic exposures, there is no evidence that typical exposures to ethoxylated surfactants will lead to dose levels that exceed the level of concern. It is unlikely that any worker would be utilizing such high levels of ethoxylated surfactants on a chronic basis, especially in the Forest Service. For a comprehensive look at the risks of ethylene oxide in ethoxylated surfactants, refer to USDA (2003).

SYLGARD® 309

Sylgard® 309 (USDA 2007c) has a "Warning" signal word. It is considered slightly irritating to the skin and is considered severely irritating to the eyes. It is not a skin sensitizer. The oral LD50 is greater than 2 g/kg (Category III) and the dermal LD50 is greater than 2 g/kg (Category III). The main ingredients in Sylgard® 309 are 3-(3-hydroxypropyl)-heptamethyltrisiloxane, ethoxylated acetate (EPA List 4); allyloxy polyethylene glycol monallyl acetate (EPA List 3); and polyethylene glycol diacetate (EPA List 3)

Besides this acute toxicity data, the MSDS describes a 28-day oral dosing study in rats, in which rats were fed doses of 0, 33, 300, or 1,000 mg/kg/day. No significant findings of biological relevance were seen in females, while males showed some effects at highest dose (body weight gain, and changes in food consumption). This would indicate a subchronic NOEL of 300 mg/kg/day. Concern has been expressed about the toxicity of silicone-based surfactants on terrestrial insects. Research does indicate that the silicone-based surfactants, because of their very effective spreading ability, may represent a risk of lethality through the physical effect of drowning, rather than through any toxicological effects. Silicone surfactants are typically used at relatively low rates and are not applied at high spray volumes because they are very effective surfactants. Hence it is unlikely that insects would be exposed to rates of application that could cause the effects noted in studies.

HI-LIGHT® BLUE

Hi-Light® Blue dye (SERA 1997; USDA 2007c) is not required to be registered as a pesticide; therefore it has no signal word associated with it. It is mildly irritating to the skin and eyes. It would likely be considered a Category III or IV material and have a "Caution" signal word if it carried one. It is a water-soluble dye that contains no listed hazardous substances. It is considered to be virtually non-toxic to humans. The dye used in Hi-Light® Blue is commonly used in toilet bowl cleaners and as a colorant for lakes and ponds.

COLORFASTTM PURPLE

Colorfast™ Purple dye (SERA 1997; USDA 2007c) is not required to be registered, and therefore it has no signal word associated with it. It is mildly irritating to the skin, but because of the acetic acid content, can be severely irritating to the eyes, and can cause permanent damage. The label requires the use of acid-resistant gloves and goggles to prevent unnecessary exposures. It would likely be considered a Category I material and have a "Danger" signal word if it carried one.

Acetic acid is the ingredient in household vinegar, although vinegars are normally 4-10% acetic acid, whereas Colorfast™ Purple contains 23.4% by weight. Acetic acid is a very strong eye and skin irritant, and eye exposure can be very hazardous, with permanent damage a possibility.

Gentian Violet, a chloride salt, is the dye component of Colorfast™ Purple. It is used as an antifungal or antibacterial medication for dermal or mucous membrane infections. In rats, there is an indication that the dye accelerates the development of leukemia; however, the effect is less remarkable than that observed in mice. It is of moderate acute toxicity, with a LD50 value of 96 mg/kg (Category II). Based on SERA (1997), risk characterization leads to typical cancer risks for workers of 4.7 x 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.

Dipropylene glycol is of low acute and chronic toxicity. It is found in many personal care products. It is a minor skin and eye irritant. It is not a carcinogen or a teratogen. The acute oral LD50 is 10.6 g/kg (IV) and the acute dermal LD50 is 20.5 g/kg (Category IV). At high (multi-gram) chronic doses, effects are seen to the kidney and liver. It is of low aquatic toxicity.

Connected Actions and Synergistic Effects

The most important connected action in the use of glyphosate involves surfactants. The glyphosate formulations proposed for use by the Rim Reforestation project recommend adding surfactants prior to application. As discussed in the Hazard Analysis section, the proprietary nature of surfactants makes them difficult to analyze. To the extent possible, however, the use of surfactants is explicitly considered in this human health risk assessment. Surfactants, by their very nature, are intended to increase the effect of a pesticide by increasing the amount of pesticide that is in contact with the target (by reducing surface tension). This is not synergism, but more accurately is a reflection of increased dose of the herbicide active ingredient into the plant (USDA 2007c).

As discussed in the Hazard Analysis section of this risk assessment, all of the additives proposed for use by the Rim reforestation project are no more than slightly toxic when ingested, inhaled, or absorbed through the skin (i.e. Acute Toxicity Categories III or IV). Therefore, the primary summary statement that can be made is that the more common risk factors for the use of these additives are through skin or eye exposure. This points to the need for good industrial hygiene practices while utilizing these products, especially when handling the concentrate, such as during mixing. The use of chemical resistant gloves and goggles, especially while mixing, should be observed (USDA 2007c).

Although there is not much data in the technical literature, there is no indication of synergistic effects between surfactants and pesticides (USDA 2007c). There are also no definite conclusions regarding the potential influence of glyphosate on the toxicity of other chemicals (SERA 2011).

Sensitive Subgroups

The most sensitive subgroup for exposure to glyphosate and glyphosate formulations appears to be pregnant women and the developing fetus. The sensitivity of this subgroup is explicitly addressed in this risk assessment because the RfD used for the Exposure Analysis and Risk Characterization is based on a developmental study (SERA 2011).

Some individuals suffer from Multiple Chemical Sensitivity (MCS). Individuals with MCS experience a variety of adverse effects as a result of exposures to very low levels of chemicals that are tolerated by individuals who do not have MCS. Diagnosis of and remediation measures for this condition are problematic, and have been suggested by some to be psychosomatic (i.e. individuals respond to a perception of hazard rather than to a specific chemical). Despite the ambiguous cause of MCS, the condition clearly exists, but is beyond the scope and authority of USDA to attempt to resolve concerns for MCS (SERA 2011).

Glossary (Human Health and Ecological Risk Assessment)

Absorption	The process by which the agent is able to pass through the body membranes and enter the bloodstream. The main routes by which toxic agents are absorbed are the gastrointestinal tract, lungs, and skin.
Acute exposure	A single exposure or multiple exposures occurring within a short time (24 hours or less).
Additive effect	A situation in which the combined effects of two chemicals is equal to the sum of the effect of each chemical given alone. The effect most commonly observed when two chemicals are given together is an additive effect.
Adjuvant(s)	Formulation factors used to enhance the pharmacological or toxic agent effect of the active ingredient.
Adverse-effect level (AEL)	Signs of toxicity that must be detected by invasive methods, external monitoring devices, or prolonged systematic observations. Symptoms that are not accompanied by grossly observable signs of toxicity. In contrast to Frank-effect level.
Assay	A kind of test (noun); to test (verb).
Carcinogen	A chemical capable of inducing cancer.
Chronic exposure	Long-term exposure studies often used to determine the carcinogenic potential of chemicals. These studies are usually performed in rats, mice, or dogs and extend over the average lifetime of the species (for a rat, exposure is 2 years).
Contaminants	For chemicals, impurities present in a commercial grade chemical. For biological agents, other agents that may be present in a commercial product.
Dermal	Pertaining to the skin.
Dose-response assessment	A description of the relationship between the dose of a chemical and the incidence of occurrence or intensity of an effect. In general, this relationship is plotted by statistical methods. Separate plots are made for experimental data obtained on different species or strains within a species.
Drift	That portion of a sprayed chemical that is moved by wind off a target site.
Endogenous	Growing or developing from or on the inside.
Enzymes	A biological catalyst; a protein, produced by an organism itself that enables the splitting (as in digestion) or fusion of other chemicals.
Epidemiology study	A study of a human population or human populations. In toxicology, a study which examines the relationship of exposures to one or more potentially toxic agent to adverse health effects in human populations.
Estrogenic	A substance that induces female hormonal activity.
Exposure assessment	The process of estimating the extent to which a population will come into contact with a chemical or biological agent.
Formulation	A commercial preparation of a chemical including any inerts or contaminants.
Frank-effect level (FEL)	The dose or concentration of a chemical or biological agent that causes gross and immediately observable signs of toxicity.
Hazard quotient (HQ)	The ratio of the estimated level of exposure to the RfD or some other index of acceptable exposure.
Hazard identification	The process of identifying the array of potential effects that an agent may induce in an exposed human population.
Hematological	Pertaining to the blood.
Herbicide	A chemical used to control, suppress, or kill plants, or to severely interrupt their normal growth processes.
In vivo	Occurring in the living organism.
In vitro	Isolated from the living organism and artificially maintained, as in a test tube.
Inerts	Adjuvants or additives in commercial formulations of pesticides that are not readily active with the other components of the mixture.

Irritant effect	A reversible effect, compared with a corrosive effect.
LC50 (lethal concentration50)	A calculated concentration of a chemical in air or water to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.
LD50 (lethal dose50)	The dose of a chemical calculated to cause death in 50% of a defined experimental animal population over a specified observation period. The observation period is typically 14 days.
Lowest-observed-adverse-effect level (LOAEL)	The lowest dose of a chemical in a study, or group of studies, that produces statistically or biologically significant increases in frequency or severity of adverse effects between the exposed population and its appropriate control.
Metabolite	A compound formed as a result of the metabolism or biochemical change of another compound.
Mutagenicity	The ability to cause genetic damage (that is damage to DNA or RNA). A mutagen is substance that causes mutations. A mutation is change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.
No-observed-adverse-effect level (NOAEL)	The dose of a chemical at which no statistically or biologically significant increases in frequency or severity of adverse effects were observed between the exposed population and its appropriate control. Effects may be produced at this dose, but they are not considered to be adverse.
No-observed-effect level (NOEL)	The dose of a chemical at which no treatment-related effects were observed.
Ocular	Pertaining to the eye.
Pathway	In metabolism, a sequence of metabolic reactions.
Reference dose (RfD)	Oral dose (mg/kg/day) not likely to be associated with adverse effects over a lifetime exposure, in the general population, including sensitive subgroups; or a daily dose which is not anticipated to cause any adverse effects in a human population over a lifetime of exposure. These values are derived by the EPA.
Reproductive effects	Adverse effects on the reproductive system that may result from exposure to a chemical or biological agent. The toxicity of the agents may be directed to the reproductive organs or the related endocrine system. The manifestations of these effects may be noted as alterations in sexual behavior, fertility, pregnancy outcomes, or modifications in other functions dependent on the integrity of this system.
Route of exposure	The way in which a chemical or biological agent enters the body. Most typical routes include oral (eating or drinking), dermal (contact of the agent with the skin), and inhalation.
Sensitive subgroup	Subpopulations that are much more sensitive than the general public to certain agents in the environment.
Subchronic exposure	An exposure duration that can last for different periods of time, but 90 days is the most common test duration. The subchronic study is usually performed in two species (rat and dog) by the route of intended use or exposure.
Synergistic effect	A situation is which the combined effects of two chemicals is much greater than the sum of the effect of each agent given alone.
Systemic toxicity	Effects that require absorption and distribution of a toxic agent to a site distant from its entry point at which point effects are produced. Systemic effects are the obverse of local effects.
Toxicity	The inherent ability of an agent to affect living organisms adversely.
Xenobiotic	A substance not naturally produced within an organism; substances foreign to an organism.

E. Treatments

This Appendix provides detailed information about the treatments described (2.01 How the Alternatives Were Developed) and proposed in the action alternatives 1, 3, 4 and 5 (2.02 Alternatives Considered in Detail) in five sections: Reforestation (E.01); Natural Regeneration (E.02); Thin Existing Plantations (E.03); Deer Reforestation (E.04); and, Deer Habitat Enhancement (E.05). The following tables display the unit numbers with treatment acres (site preparation, fuels reduction, planting, release, prescribed fire, etc.) using a common legend.[9]

E.01 REFORESTATION

Table E.01-1 Alternative 1: Reforestation Treatments

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
AA01B		73					73		73	73	73
AA03C	2							2	2	2	2
AA04C	4							4	4	4	4
AA04D	2							2	2	2	2
AA008							231		231	231	231
AA010							135		135	135	135
AA012								22	22	22	22
AA015								37	37	37	37
AA016								24	24	24	24
AA017								47	47	47	47
AA018						2		32	32	32	32
AA019	3							50	50	50	50
AA020	57							63	63	63	63
AA23B	10							10	10	10	10
AA23C	6							6	6	6	6
BB004								59	59	59	59
BB005								16	16	16	16
BB006							65		65	65	65
BB007								43	43	43	43
BB008				4				161	161	161	161
BB009							24		24	24	24
BB010								87	87	87	87
BB011							55		55	55	55
BB012								87	87	87	87
BB014				2			32		32	32	32
BB015				3			48		48	48	48
BB016								43	43	43	43
BB017								20	20	20	20
BB020								66	66	66	66
BB021				4			125		125	125	125
BB022				4				113	113	113	113
BB23B	2							2	2	2	2
BB23C	6							6	6	6	6
BB024						43		53	53	53	53
BB025								32	32	32	32
BB026								19	19	19	19

[9] Legend: DTFC=Deep Till With Forest Cultivation; FB=Feller Buncher; GRUB=hand removal; HC=Hand Cut; HERB=manual herbicide application; HP=Hand Pile; JP=Jackpot Burn; MA=Masticate; MP=Machine Pile (with dozer); NAT=Natural Regeneration; PCT=Pre-Commercial Thin; PF=Prescribed Fire; PPF=Post-planting Prescribed Fire; SP=Site Preparation; REL=Release.

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
BB029							51		51	51	51
BB033								59	59	59	59
BB035								141	141	141	141
BB036								92	92	92	92
BB040						13		13	13	13	13
BB041		35						65	65	65	65
BB43B	4							4	4	4	4
BB43C	5							5	5	5	5
BB045				22				269	269	269	269
BB047							41		41	41	41
BB049				14				198	198	198	198
BB050								44	44	44	44
BB051								101	101	101	101
BB053								75	75	75	75
BB056								12	12	12	12
BB059	8							27	27	27	27
BB060								29	29	29	29
BB062							23		23	23	23
BB063								21	21	21	21
BB064								24	24	24	24
BB065							54		54	54	54
BB066							28		28	28	28
BB71B	6							6	6	6	6
BB71C	10							10	10	10	10
BB073							21		21	21	21
BB075							12		12	12	12
BB076								38	38	38	38
BB077								9	9	9	9
BB080	2						23		23	23	23
CC009	17						17		17	17	17
CC013	11							11	11	11	11
D014								111	111	111	111
DD001								54	54	54	54
DD002								19	19	19	19
DD003							29		29	29	29
DD04B	8							8	8	8	8
DD05B				3			3		3	3	3
DD05C				5			5		5	5	5
DD006								52	52	52	52
DD007								28	28	28	28
DD013								9	9	9	9
DD014								13	13	13	13
DD015						9		9	9	9	9
DD018							17		17	17	17
E002B	14							14	14	14	14
E002C	3							3	3	3	3
E003B	16							16	16	16	16
E006B	7							7	7	7	7
E006C	27							27	27	27	27
EE03B		8						8	8	8	8
E007C	13							13	13	13	13
FF001								9	9	9	9
FF002								14	14	14	14
FF003	5							70	70	70	70
FF007								96	96	96	96
FF008							68		68	68	68
GG001								12	12	12	12

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
GG002								23	23	23	23
GG08B		27						27	27	27	27
GG08C		6						6	6	6	6
GG010								41	41	41	41
GG12B					3			3	3	3	3
GG12C					2			2	2	2	2
GG015								19	19	19	19
GG020						12		265	265	265	265
GG021								8	8	8	8
GG023								76	76	76	76
GG025								52	52	52	52
GG026								6	6	6	6
GG027								346	346	346	346
GG031								34	34	34	34
GG032							9		9	9	9
GG034								24	24	24	24
GG37B		12						12	12	12	12
GG37C		30						30	30	30	30
GG048		14						14	14	14	14
GG50B	28							28	28	28	28
GG50C	4							4	4	4	4
GG51B	57							57	57	57	57
GG55B	24							24	24	24	24
GG55C	13							13	13	13	13
GG56B	2							2	2	2	2
GG56C	5							5	5	5	5
GG56D	1							1	1	1	1
GG57B	16							16	16	16	16
GG57C	14							14	14	14	14
GG58A	2						2		2	2	2
GG063						21		21	21	21	21
H009C	31							31	31	31	31
H011B		11						11	11	11	11
H011D		27						27	27	27	27
H016						24		24	24	24	24
H017						47		47	47	47	47
H032B		17						17	17	17	17
H033B		11						11	11	11	11
H034B		7						7	7	7	7
H039						27		27	27	27	27
H049B	7							7	7	7	7
H065								13	13	13	13
H068								54	54	54	54
HH001								67	67	67	67
HH002								93	93	93	93
HH003								116	116	116	116
HH006							104		104	104	104
HH007								22	22	22	22
HH008								9	9	9	9
HH009							22		22	22	22
HH010								41	41	41	41
HH011							46		46	46	46
HH012								34	34	34	34
HH013	3						64		64	64	64
HH014	22						131		131	131	131
HH015								83	83	83	83
HH016								50	50	50	50

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
HH17B	10							10	10	10	10
HH018				11				47	47	47	47
HH20C		11						11	11	11	11
HH028								18	18	18	18
HH029				107				116	116	116	116
HH037						5		37	37	37	37
HH038	37							93	93	93	93
HH39B	13							13	13	13	13
HH40B	3							3	3	3	3
HH42B	16							16	16	16	16
HH45D				108				108	108	108	108
HH45E				55				55	55	55	55
I007B					24			24	24	24	24
I007C					21			21	21	21	21
I009D		51						51	51	51	51
I009E		5						5	5	5	5
I014B		59						59	59	59	59
I015		37						37	37	37	37
I017C	19							19	19	19	19
I020B					24			24	24	24	24
I024C	1							1	1	1	1
I024D	4							4	4	4	4
I025C	24							24	24	24	24
I025D	6							6	6	6	6
I028B	2							2	2	2	2
I028C	12							12	12	12	12
I029C	6							6	6	6	6
I033B	6							6	6	6	6
I047B	3							3	3	3	3
I047C	11							11	11	11	11
I048B	3							3	3	3	3
I058B	2							2	2	2	2
I058C	3							3	3	3	3
I058D	13							13	13	13	13
I060B	58							58	58	58	58
I061B		12						12	12	12	12
I062C		15						15	15	15	15
I063B				15				15	15	15	15
I063C				3				3	3	3	3
I065A				2				2	2	2	2
I065C				4				4	4	4	4
I070A	11							11	11	11	11
I070C	8							8	8	8	8
I071B	8							8	8	8	8
I071C	2							2	2	2	2
I072C	45							45	45	45	45
I073B	3							3	3	3	3
I073C	36							36	36	36	36
I075B	12							12	12	12	12
I075C	2							2	2	2	2
I080B	12							12	12	12	12
I084B	29							29	29	29	29
I086B	7							7	7	7	7
I088A	11							11	11	11	11
I089B				22			22		22	22	22
I090B	11							11	11	11	11
I096	20							20	20	20	20

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
I099B	5							5	5	5	5
I099C	1							1	1	1	1
I100C	64							64	64	64	64
I101A	5							5	5	5	5
I102B	3							3	3	3	3
I103C	8							8	8	8	8
I104C	23							23	23	23	23
I104D	3							3	3	3	3
I109B	11							11	11	11	11
I110B	6							6	6	6	6
I111B	8							8	8	8	8
I112B	6							6	6	6	6
I113C	9							9	9	9	9
I121A	3							3	3	3	3
I121B	5							5	5	5	5
I121C	3							3	3	3	3
I122C	13							13	13	13	13
I122D	5							5	5	5	5
I122E	24							24	24	24	24
I123B	35							35	35	35	35
I124B	19							19	19	19	19
I125B	18							18	18	18	18
I126B	14							14	14	14	14
I127	24							24	24	24	24
I128C	16							16	16	16	16
I129	30							30	30	30	30
I130	34							34	34	34	34
I131B	27							27	27	27	27
I132B	54							54	54	54	54
I133	19							19	19	19	19
I134B	22							22	22	22	22
I135B	13							13	13	13	13
I136B	2							2	2	2	2
I136C	22							22	22	22	22
I137B	36							36	36	36	36
I138	21							21	21	21	21
I139	25							25	25	25	25
I140B		40						40	40	40	40
J001								69	69	69	69
J002								243	243	243	243
J003								100	100	100	100
J004								73	73	73	73
J005								161	161	161	161
J012								46	46	46	46
K010C	119							119	119	119	119
K011B	2							2	2	2	2
K011C	15							15	15	15	15
K015B	39							39	39	39	39
K018A	75						75		75	75	75
L001		188						188	188	188	188
L002	92							96	96	96	96
L003		86						100	100	100	100
L005				97				120	120	120	120
L006								116	116	116	116
L007								111	111	111	111
L008								152	152	152	152
L009								66	66	66	66

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
L010							22		22	22	22
L011							48		48	48	48
L014		155						155	155	155	155
M001C			67					67	67	67	67
M001E			102					102	102	102	102
M001G			182					182	182	182	182
M004B	121							121	121	121	121
M009B	29							29	29	29	29
M010B	29							29	29	29	29
M010D	44							44	44	44	44
M011A	28							28	28	28	28
M014A	7							7	7	7	7
M014C	9							9	9	9	9
M017B				62				62	62	62	62
M017C				33				33	33	33	33
M020A	19							19	19	19	19
M020C	31							31	31	31	31
M024B	156							156	156	156	156
M025								219	219	219	219
N010B		113						113	113	113	113
N019				213				221	221	221	221
P010							61		61	61	61
P011								23	23	23	23
P014	4						255		255	255	255
P021								149	149	149	149
P022								61	61	61	61
Q002B	248							248	248	248	248
Q002C	10							10	10	10	10
Q002D	3							3	3	3	3
Q003								21	21	21	21
Q004								32	32	32	32
Q005							9		9	9	9
Q006							24		24	24	24
Q007							33		33	33	33
Q008							29		29	29	29
Q009								88	88	88	88
Q010								24	24	24	24
Q013							23		23	23	23
Q014							24		24	24	24
Q015							46		46	46	46
Q016							75		75	75	75
Q017								73	73	73	73
R001								185	185	185	185
R002				4				92	92	92	92
R003								38	38	38	38
R004	104							121	121	121	121
R005							49		49	49	49
R006								39	39	39	39
R007B				3			3		3	3	3
R007C				16			16		16	16	16
R008							9		9	9	9
R009								19	19	19	19
R011								54	54	54	54
R012							48		48	48	48
R013								41	41	41	41
R014B	65							65	65	65	65
R015								15	15	15	15

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
R016								38	38	38	38
R017								14	14	14	14
R019								33	33	33	33
R020								13	13	13	13
R021								21	21	21	21
R022							72		72	72	72
R024							85		85	85	85
R025							174		174	174	174
R026						9		48	48	48	48
R027								60	60	60	60
R028							17		17	17	17
R029							10		10	10	10
R030							24		24	24	24
R031							30		30	30	30
R032							30		30	30	30
R034								33	33	33	33
R036								17	17	17	17
R037						13		132	132	132	132
R038							46		46	46	46
R039	5							10	10	10	10
R046							233		233	233	233
S001							282		282	282	282
S006								32	32	32	32
S007								106	106	106	106
T002								52	52	52	52
T003								78	78	78	78
T004								20	20	20	20
T005								116	116	116	116
T006							461		461	461	461
T007							342		342	342	342
T008							32		32	32	32
T009							47		47	47	47
T010								94	94	94	94
T011								198	198	198	198
T012								71	71	71	71
T013								80	80	80	80
T014								18	18	18	18
T015	14							64	64	64	64
T017	7							45	45	45	45
T019	9							36	36	36	36
T025								71	71	71	71
U003								239	239	239	239
U004		50						50	50	50	50
U005							18		18	18	18
U008								15	15	15	15
U009								48	48	48	48
U010	1							13	13	13	13
U011								24	24	24	24
U012								94	94	94	94
U013								51	51	51	51
U014								5	5	5	5
U015						12		40	40	40	40
U016								28	28	28	28
U018								97	97	97	97
U019								130	130	130	130
U020								51	51	51	51
U021								10	10	10	10

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
V010B	55							55	55	55	55
V012				88			112		112	112	112
V014B	23							23	23	23	23
V015	32							32	32	32	32
V022B	5							5	5	5	5
V022C	11							11	11	11	11
V022D	11							11	11	11	11
V023B		16						16	16	16	16
V024		237						237	237	237	237
W002								226	226	226	226
W003								73	73	73	73
W004B	8							8	8	8	8
W004C	4							4	4	4	4
X003							20		20	20	20
X011								22	22	22	22
X013B	2						2		2	2	2
X013C	3						3		3	3	3
X014								46	46	46	46
X015								64	64	64	64
X019								73	73	73	73
X021								34	34	34	34
X025							12		12	12	12
X026							48		48	48	48
X028							74		74	74	74
X033				4				65	65	65	65
X035							67		67	67	67
X036							240		240	240	240
X037								88	88	88	88
Y002C	86							86	86	86	86
Y008	3							33	33	33	33
Y010		25						25	25	25	25
Y011		10						10	10	10	10
Y014		23						23	23	23	23
Y015		18						18	18	18	18
Y016		17						17	17	17	17
Y018		47						48	48	48	48
Y020				4				50	50	50	50
Y025								69	69	69	69
Y028							6		6	6	6
Y029								52	52	52	52
Y030								143	143	143	143
Z006								20	20	20	20
Z008								15	15	15	15
Z011								91	91	91	91
Z013								38	38	38	38
Z014								17	17	17	17
Z016	7							60	60	60	60
Z017								20	20	20	20
Z018								7	7	7	7
Z020								36	36	36	36
Z021	4							43	43	43	43
Z024								50	50	50	50
Z027								88	88	88	88
Z028							137		137	137	137
Z029							32		32	32	32
Z030	18							44	44	44	44
Total	**3,139**	**1,493**	**351**	**912**	**74**	**237**	**5,085**	**16,215**	**21,300**	**21,300**	**21,300**

Table E.01-2 Alternative 3: Reforestation Treatments

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	PLANT	GRUB	PPF
AA01B		73					73	73	73	73
AA03C	2							2	2	2
AA04C	4						4	4	4	4
AA04D	2						2	2	2	2
AA008							231	231	231	231
AA010							135	135	135	135
AA012							22	22	22	22
AA015							37	37	37	37
AA016								24	24	24
AA017								47	47	47
AA018						2		32	32	32
AA019	3							50	50	50
AA020	57							63	63	63
AA23B	10							10	10	10
AA23C	6							6	6	6
BB004							59	59	59	59
BB005								16	16	16
BB006							65	65	65	65
BB007								43	43	43
BB008				4			161	161	161	161
BB009							24	24	24	24
BB010							87	87	87	87
BB011							55	55	55	55
BB012								87	87	87
BB014				2			32	32	32	32
BB015				3			48	48	48	48
BB016								43	43	43
BB017								20	20	20
BB020							66	66	66	66
BB021				4			125	125	125	125
BB022				4				113	113	113
BB23B	2							2	2	2
BB23C	6							6	6	6
BB024						43		53	53	53
BB025							32	32	32	32
BB026							19	19	19	19
BB029							51	51	51	51
BB033							59	59	59	59
BB035							141	141	141	141
BB036							92	92	92	92
BB040						13		13	13	13
BB041		35						65	65	65
BB43B	4							4	4	4
BB43C	5							5	5	5
BB045				22				269	269	269
BB047							41	41	41	41
BB049				14				198	198	198
BB050								44	44	44
BB051								101	101	101
BB053								75	75	75
BB056								12	12	12
BB059	8							27	27	27
BB060								29	29	29
BB062							23	23	23	23
BB063								21	21	21

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	PLANT	GRUB	PPF
BB064								24	24	24
BB065							54	54	54	54
BB066							28	28	28	28
BB71B	6							6	6	6
BB71C	10							10	10	10
BB073							21	21	21	21
BB075							12	12	12	12
BB076							38	38	38	38
BB077								9	9	9
BB080	2						23	23	23	23
CC009	17						17	17	17	17
CC013	11							11	11	11
D014							111	111	111	111
DD001								54	54	54
DD002								19	19	19
DD003							29	29	29	29
DD04B	8							8	8	8
DD05B				3			3	3	3	3
DD05C				5			5	5	5	5
DD006								52	52	52
DD007								28	28	28
DD013								9	9	9
DD014								13	13	13
DD015						9		9	9	9
DD018							17	17	17	17
E002B	14						14	14	14	14
E002C	3							3	3	3
E003B	16							16	16	16
E006B	7							7	7	7
E006C	27							27	27	27
EE03B		8						8	8	8
E007C	13							13	13	13
FF001								9	9	9
FF002								14	14	14
FF003	5							70	70	70
FF007							96	96	96	96
FF008							68	68	68	68
GG001								12	12	12
GG002								23	23	23
GG08B		27						27	27	27
GG08C		6						6	6	6
GG010								41	41	41
GG12B					3			3	3	3
GG12C					2			2	2	2
GG015								19	19	19
GG020						12		265	265	265
GG021								8	8	8
GG023								76	76	76
GG025								52	52	52
GG026								6	6	6
GG027								346	346	346
GG031								34	34	34
GG032							9	9	9	9
GG034								24	24	24
GG37B		12						12	12	12
GG37C		30						30	30	30
GG048		14						14	14	14

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	PLANT	GRUB	PPF
GG50B	28							28	28	28
GG50C	4							4	4	4
GG51B	57							57	57	57
GG55B	24							24	24	24
GG55C	13							13	13	13
GG56B	2							2	2	2
GG56C	5							5	5	5
GG56D	1							1	1	1
GG57B	16							16	16	16
GG57C	14							14	14	14
GG58A	2						2	2	2	2
GG063						21		21	21	21
H009C	31							31	31	31
H011B		11						11	11	11
H011D		27						27	27	27
H016						24		24	24	24
H017						47		47	47	47
H032B		17						17	17	17
H033B		11						11	11	11
H034B		7						7	7	7
H039						27		27	27	27
H049B	7							7	7	7
H065								13	13	13
H068								54	54	54
HH001							67	67	67	67
HH002								93	93	93
HH003							116	116	116	116
HH006							104	104	104	104
HH007								22	22	22
HH008								9	9	9
HH009							22	22	22	22
HH010							41	41	41	41
HH011							46	46	46	46
HH012								34	34	34
HH013	3						64	64	64	64
HH014	22						131	131	131	131
HH015								83	83	83
HH016								50	50	50
HH17B	10							10	10	10
HH018				11				47	47	47
HH20C		11						11	11	11
HH028							18	18	18	18
HH029				107			116	116	116	116
HH037						5		37	37	37
HH038	37							93	93	93
HH39B	13						13	13	13	13
HH40B	3						3	3	3	3
HH42B	16						16	16	16	16
HH45D				108			108	108	108	108
HH45E				55			55	55	55	55
I007B					24			24	24	24
I007C					21			21	21	21
I009D		51						51	51	51
I009E		5						5	5	5
I014B		59						59	59	59
I015		37						37	37	37
I017C	19							19	19	19

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	PLANT	GRUB	PPF
I020B					24			24	24	24
I024C	1							1	1	1
I024D	4							4	4	4
I025C	24							24	24	24
I025D	6							6	6	6
I028B	2							2	2	2
I028C	12							12	12	12
I029C	6							6	6	6
I033B	6							6	6	6
I047B	3							3	3	3
I047C	11							11	11	11
I048B	3							3	3	3
I058B	2							2	2	2
I058C	3							3	3	3
I058D	13							13	13	13
I060B	58						58	58	58	58
I061B		12						12	12	12
I062C		15						15	15	15
I063B				15				15	15	15
I063C				3				3	3	3
I065A				2			2	2	2	2
I065C				4			4	4	4	4
I070A	11							11	11	11
I070C	8							8	8	8
I071B	8							8	8	8
I071C	2							2	2	2
I072C	45							45	45	45
I073B	3							3	3	3
I073C	36							36	36	36
I075B	12						12	12	12	12
I075C	2						2	2	2	2
I080B	12							12	12	12
I084B	29						29	29	29	29
I086B	7							7	7	7
I088A	11							11	11	11
I089B				22			22	22	22	22
I090B	11							11	11	11
I096	20							20	20	20
I099B	5							5	5	5
I099C	1							1	1	1
I100C	64							64	64	64
I101A	5							5	5	5
I102B	3							3	3	3
I103C	8							8	8	8
I104C	23							23	23	23
I104D	3							3	3	3
I109B	11							11	11	11
I110B	6							6	6	6
I111B	8							8	8	8
I112B	6							6	6	6
I113C	9							9	9	9
I121A	3							3	3	3
I121B	5							5	5	5
I121C	3							3	3	3
I122C	13							13	13	13
I122D	5							5	5	5
I122E	24							24	24	24

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	PLANT	GRUB	PPF
I123B	35							35	35	35
I124B	19							19	19	19
I125B	18							18	18	18
I126B	14							14	14	14
I127	24							24	24	24
I128C	16							16	16	16
I129	30							30	30	30
I130	34							34	34	34
I131B	27							27	27	27
I132B	54							54	54	54
I133	19							19	19	19
I134B	22							22	22	22
I135B	13							13	13	13
I136B	2							2	2	2
I136C	22							22	22	22
I137B	36							36	36	36
I138	21							21	21	21
I139	25							25	25	25
I140B		40						40	40	40
J001								69	69	69
J002								243	243	243
J003								100	100	100
J004								73	73	73
J005								161	161	161
J012								46	46	46
K010C	119							119	119	119
K011B	2							2	2	2
K011C	15							15	15	15
K015B	39							39	39	39
K018A	75						75	75	75	75
L001		188						188	188	188
L002	92							96	96	96
L003		86						100	100	100
L005				97			120	120	120	120
L006								116	116	116
L007								111	111	111
L008								152	152	152
L009								66	66	66
L010							22	22	22	22
L011							48	48	48	48
L014		155					155	155	155	155
M001C			67					67	67	67
M001E			102					102	102	102
M001G			182					182	182	182
M004B	121							121	121	121
M009B	29							29	29	29
M010B	29							29	29	29
M010D	44							44	44	44
M011A	28							28	28	28
M014A	7							7	7	7
M014C	9							9	9	9
M017B				62				62	62	62
M017C				33				33	33	33
M020A	19							19	19	19
M020C	31							31	31	31
M024B	156							156	156	156
M025								219	219	219

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	PLANT	GRUB	PPF
N010B		113					113	113	113	113
N019				213			221	221	221	221
P010							61	61	61	61
P011								23	23	23
P014	4						255	255	255	255
P021								149	149	149
P022								61	61	61
Q002B	248							248	248	248
Q002C	10							10	10	10
Q002D	3							3	3	3
Q003							21	21	21	21
Q004								32	32	32
Q005							9	9	9	9
Q006							24	24	24	24
Q007							33	33	33	33
Q008							29	29	29	29
Q009								88	88	88
Q010								24	24	24
Q013							23	23	23	23
Q014							24	24	24	24
Q015							46	46	46	46
Q016							75	75	75	75
Q017								73	73	73
R001								185	185	185
R002				4				92	92	92
R003								38	38	38
R004	104							121	121	121
R005							49	49	49	49
R006								39	39	39
R007B				3			3	3	3	3
R007C				16			16	16	16	16
R008							9	9	9	9
R009								19	19	19
R011							54	54	54	54
R012							48	48	48	48
R013								41	41	41
R014B	65						65	65	65	65
R015								15	15	15
R016								38	38	38
R017								14	14	14
R019								33	33	33
R020								13	13	13
R021							21	21	21	21
R022							72	72	72	72
R024							85	85	85	85
R025							174	174	174	174
R026						9		48	48	48
R027								60	60	60
R028							17	17	17	17
R029							10	10	10	10
R030							24	24	24	24
R031							30	30	30	30
R032							30	30	30	30
R034								33	33	33
R036							17	17	17	17
R037						13		132	132	132
R038							46	46	46	46

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	PLANT	GRUB	PPF
R039	5							10	10	10
R046							233	233	233	233
S001							282	282	282	282
S006								32	32	32
S007								106	106	106
T002							52	52	52	52
T003								78	78	78
T004								20	20	20
T005								116	116	116
T006							461	461	461	461
T007							342	342	342	342
T008							32	32	32	32
T009							47	47	47	47
T010								94	94	94
T011							198	198	198	198
T012								71	71	71
T013								80	80	80
T014								18	18	18
T015	14						64	64	64	64
T017	7							45	45	45
T019	9						36	36	36	36
T025								71	71	71
U003							239	239	239	239
U004		50						50	50	50
U005							18	18	18	18
U008							15	15	15	15
U009								48	48	48
U010	1							13	13	13
U011							24	24	24	24
U012								94	94	94
U013								51	51	51
U014							5	5	5	5
U015						12		40	40	40
U016							28	28	28	28
U018								97	97	97
U019								130	130	130
U020								51	51	51
U021								10	10	10
V010B	55							55	55	55
V012				88			112	112	112	112
V014B	23							23	23	23
V015	32						32	32	32	32
V022B	5							5	5	5
V022C	11							11	11	11
V022D	11							11	11	11
V023B		16						16	16	16
V024		237						237	237	237
W002							226	226	226	226
W003								73	73	73
W004B	8						8	8	8	8
W004C	4						4	4	4	4
X003							20	20	20	20
X011							22	22	22	22
X013B	2						2	2	2	2
X013C	3						3	3	3	3
X014								46	46	46
X015							64	64	64	64

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	PLANT	GRUB	PPF
X019								73	73	73
X021								34	34	34
X025							12	12	12	12
X026							48	48	48	48
X028							74	74	74	74
X033				4				65	65	65
X035							67	67	67	67
X036							240	240	240	240
X037								88	88	88
Y002C	86							86	86	86
Y008	3							33	33	33
Y010		25					25	25	25	25
Y011		10					10	10	10	10
Y014		23					23	23	23	23
Y015		18					18	18	18	18
Y016		17						17	17	17
Y018		47						48	48	48
Y020				4			50	50	50	50
Y025								69	69	69
Y028							6	6	6	6
Y029							52	52	52	52
Y030								143	143	143
Z006								20	20	20
Z008								15	15	15
Z011								91	91	91
Z013							38	38	38	38
Z014								17	17	17
Z016	7							60	60	60
Z017								20	20	20
Z018								7	7	7
Z020								36	36	36
Z021	4							43	43	43
Z024								50	50	50
Z027							88	88	88	88
Z028							137	137	137	137
Z029							32	32	32	32
Z030	18							44	44	44
Total	**3,139**	**1,493**	**351**	**912**	**74**	**237**	**8,893**	**21,300**	**21,300**	**21,300**

Table E.01-3 Alternative 4: Reforestation Treatments

Unit	FB	MA	MP	HC/JP	HERB/SP	PLANT	HERB/REL	PPF
AA008					46	46	65	46
AA010					27	27	38	27
AA012					4	4	6	4
AA015					7	7	10	7
AA016					5	5	7	5
AA017					9	9	13	9
AA018				2	6	6	9	6
AA019	3				10	10	14	10
BB004					12	12	17	12
BB005					3	3	5	3
BB006					13	13	18	13
BB007					9	9	12	9
BB008			4		32	32	45	32
BB009					5	5	7	5
BB010					17	17	24	17
BB011					11	11	15	11
BB012					17	17	24	17
BB014			2		6	6	9	6
BB015			3		10	10	13	10
BB016					9	9	12	9
BB017					4	4	5	4
BB020					13	13	18	13
BB021			4		25	25	35	25
BB022			4		23	23	32	23
BB025					6	6	9	6
BB026					4	4	5	4
BB029					10	10	14	10
BB033					12	12	17	12
BB035					28	28	39	28
BB036					18	18	26	18
BB040				4	3	3	4	3
BB041		18			13	13	18	13
BB045			22		54	54	75	54
BB047					8	8	12	8
BB049			14		40	40	55	40
BB050					9	9	12	9
BB051					20	20	28	20
BB053					15	15	21	15
BB059	8				5	5	8	5
BB060					6	6	8	6
BB062					5	5	6	5
BB063					4	4	6	4
BB064					5	5	7	5
BB065					11	11	15	11
BB066					6	6	8	6
BB073					4	4	6	4
BB075					2	2	3	2
BB076					8	8	11	8
D014					22	22	31	22
DD006					10	10	15	10
DD007					6	6	8	6
DD014					3	3	4	3
FF002					3	3	4	3
FF003	5				14	14	20	14
FF007					19	19	27	19

Unit	FB	MA	MP	HC/JP	HERB/SP	PLANT	HERB/REL	PPF
FF008					14	14	19	14
GG010					8	8	11	8
GG015					4	4	5	4
GG020				12	53	53	74	53
GG023					15	15	21	15
GG025					10	10	15	10
GG027					69	69	97	69
GG031					7	7	9	7
GG034					5	5	7	5
H065					3	3	4	3
H068					11	11	15	11
HH001					13	13	19	13
HH003					23	23	32	23
HH006					21	21	29	21
HH007					4	4	6	4
HH009					4	4	6	4
HH010					8	8	11	8
HH011					9	9	13	9
HH012					7	7	9	7
HH013	3				13	13	18	13
HH014	22				26	26	37	26
HH015					17	17	23	17
HH018			11		9	9	13	9
HH028					4	4	5	4
HH038	26				19	19	26	19
J001					14	14	19	14
J002					49	49	68	49
J003					20	20	28	20
J004					15	15	20	15
J005					32	32	45	32
J012					9	9	13	9
L006					23	23	33	23
L007					22	22	31	22
L008					30	30	43	30
L009					13	13	19	13
L010					4	4	6	4
L011					10	10	14	10
M025					44	44	61	44
P014	4				51	51	71	51
P021					30	30	42	30
Q006					5	5	7	5
Q007					7	7	9	7
Q008					6	6	8	6
Q009					18	18	25	18
Q013					5	5	6	5
Q014					5	5	7	5
Q015					9	9	13	9
Q016					15	15	21	15
R001					37	37	52	37
R002			4		18	18	26	18
R003					8	8	11	8
R004	34				24	24	34	24
R005					10	10	14	10
R006					8	8	11	8
R011					11	11	15	11
R012					10	10	14	10
R013					8	8	11	8

Unit	FB	MA	MP	HC/JP	HERB/SP	PLANT	HERB/REL	PPF
R015					3	3	4	3
R016					8	8	11	8
R019					7	7	9	7
R021					4	4	6	4
R022					14	14	20	14
R024					18	18	24	18
R025					35	35	49	35
R026				9	10	10	14	10
R027					12	12	17	12
R028					3	3	5	3
R030					5	5	7	5
R031					6	6	8	6
R032					6	6	8	6
R034					7	7	9	7
R036					3	3	5	3
R037				13	26	26	37	26
R038					9	9	13	9
R046					47	47	65	47
S001					56	56	79	56
S006					6	6	9	6
S007					21	21	30	21
T002					10	10	15	10
T003					16	16	22	16
T004					4	4	6	4
T005					23	23	33	23
T006					92	92	129	92
T007					68	68	96	68
T008					6	6	9	6
T010					19	19	26	19
T011					40	40	55	40
T012					14	14	20	14
T013					16	16	23	16
T014					4	4	5	4
T015	14				13	13	18	13
T019	9				7	7	10	7
T025					14	14	20	14
U003					48	48	67	48
U004		14			10	10	14	10
U005					4	4	5	4
U010	1				3	3	4	3
U011					5	5	7	5
U012					19	19	26	19
U013					10	10	14	10
U015				11	8	8	11	8
U018					19	19	27	19
U019					26	26	36	26
U020					10	10	14	10
U021					2	2	3	2
W002					45	45	63	45
W003					15	15	20	15
X011					4	4	6	4
X014					9	9	13	9
X015					13	13	18	13
X019					15	15	20	15
X021					7	7	9	7
X025					2	2	3	2
X028					15	15	21	15

Unit	FB	MA	MP	HC/JP	HERB/SP	PLANT	HERB/REL	PPF
X033			4		13	13	18	13
X035					13	13	19	13
X036					48	48	67	48
X037					18	18	25	18
Y020			4		10	10	14	10
Y025					14	14	19	14
Y029					10	10	15	10
Y030					29	29	40	29
Z006					4	4	6	4
Z008					3	3	4	3
Z011					18	18	26	18
Z013					8	8	11	8
Z014					3	3	5	3
Z016	7				12	12	17	12
Z017					4	4	5	4
Z020					7	7	10	7
Z021	4				9	9	12	9
Z024					10	10	14	10
Z027					18	18	25	18
Z028					27	27	38	27
Z029					6	6	9	6
Total	**140**	**32**	**76**	**51**	**2,867**	**2,867**	**4,012**	**2,867**

Table E.01-4 Alternative 5: Reforestation Treatments

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
AA01B		73					73		73	73	73
AA03C	2							2	2	2	2
AA04C	4							4	4	4	4
AA04D	2							2	2	2	2
AA008							231		231	231	231
AA010							135		135	135	135
AA012								22	22	22	22
AA015								37	37	37	37
AA016								24	24	24	24
AA017								47	47	47	47
AA018						2		32	32	32	32
AA019	3							50	50	50	50
AA020	57							63	63	63	63
AA23B	10							10	10	10	10
AA23C	6							6	6	6	6
B001								62	62	62	62
B002								100	100	100	100
BB004								59	59	59	59
BB005								16	16	16	16
BB006							65		65	65	65
BB007								43	43	43	43
BB008				4				161	161	161	161
BB009							24		24	24	24
BB010								87	87	87	87
BB011							55		55	55	55
BB012								87	87	87	87
BB014				2			32		32	32	32
BB015				3			48		48	48	48
BB016								43	43	43	43
BB017								20	20	20	20
BB020								66	66	66	66
BB021				4			125		125	125	125
BB022				4				113	113	113	113
BB23B	2							2	2	2	2
BB23C	6							6	6	6	6
BB024						43		53	53	53	53
BB025								32	32	32	32
BB026								19	19	19	19
BB028								162	162	162	162
BB029							51		51	51	51
BB033								59	59	59	59
BB035								141	141	141	141
BB036								92	92	92	92
BB038		3						25	25	25	25
BB040						13		13	13	13	13
BB041		35						65	65	65	65
BB43B	4							4	4	4	4
BB43C	5							5	5	5	5
BB045				22				269	269	269	269
BB046								13	13	13	13
BB047							41		41	41	41
BB049				14				198	198	198	198
BB050								44	44	44	44
BB051								101	101	101	101
BB053								75	75	75	75

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
BB055								11	11	11	11
BB056								12	12	12	12
BB057								28	28	28	28
BB059	8							27	27	27	27
BB060								29	29	29	29
BB062							23		23	23	23
BB063								21	21	21	21
BB064								24	24	24	24
BB065							54		54	54	54
BB066							28		28	28	28
BB069								72	72	72	72
BB71B	6							6	6	6	6
BB71C	10							10	10	10	10
BB072								29	29	29	29
BB073							21		21	21	21
BB075							12		12	12	12
BB076								38	38	38	38
BB077								9	9	9	9
BB080	2						23		23	23	23
BB083								94	94	94	94
CC009	17						17		17	17	17
CC010								11	11	11	11
CC013	11							11	11	11	11
D014								111	111	111	111
DD001								54	54	54	54
DD002								19	19	19	19
DD003							29		29	29	29
DD04B	8							8	8	8	8
DD05B				3			3		3	3	3
DD05C				5			5		5	5	5
DD006								52	52	52	52
DD007								28	28	28	28
DD013								9	9	9	9
DD014								13	13	13	13
DD015						9		9	9	9	9
DD016								83	83	83	83
DD018							17		17	17	17
E002B	14							14	14	14	14
E002C	3							3	3	3	3
E003B	16							16	16	16	16
E006B	7							7	7	7	7
E006C	27							27	27	27	27
E007C	13							13	13	13	13
E008	8							17	17	17	17
E009								42	42	42	42
E010								11	11	11	11
E011								26	26	26	26
E012								31	31	31	31
EE03B		8						8	8	8	8
EE013								34	34	34	34
FF001								9	9	9	9
FF002								14	14	14	14
FF003	5							70	70	70	70
F007								65	65	65	65
FF007								96	96	96	96
FF008							68		68	68	68
FF009								61	61	61	61

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
FF010								34	34	34	34
G011								16	16	16	16
G012					5			5	5	5	5
G013								5	5	5	5
G014					176			176	176	176	176
G015								4	4	4	4
GG001								12	12	12	12
GG002								23	23	23	23
GG004								7	7	7	7
GG005								43	43	43	43
GG006								3	3	3	3
GG007								65	65	65	65
GG08B		27						27	27	27	27
GG08C		6						6	6	6	6
GG010								41	41	41	41
GG12B					3			3	3	3	3
GG12C					2			2	2	2	2
GG013								23	23	23	23
GG015								19	19	19	19
GG020						12		265	265	265	265
GG021								8	8	8	8
GG022								27	27	27	27
GG023								76	76	76	76
GG024								75	75	75	75
GG025								52	52	52	52
GG026								6	6	6	6
GG027								346	346	346	346
GG028								70	70	70	70
GG029								183	183	183	183
GG030								13	13	13	13
GG031								34	34	34	34
GG032							9		9	9	9
GG033								18	18	18	18
GG034								24	24	24	24
GG035								72	72	72	72
GG036								28	28	28	28
GG37B		12						12	12	12	12
GG37C		30						30	30	30	30
GG041	18							49	49	49	49
GG042		26						26	26	26	26
GG043	4							26	26	26	26
GG045								10	10	10	10
GG046								16	16	16	16
GG047	2							47	47	47	47
GG048		14						14	14	14	14
GG50B	28							28	28	28	28
GG50C	4							4	4	4	4
GG51B	57							57	57	57	57
GG55B	24							24	24	24	24
GG55C	13							13	13	13	13
GG56B	2							2	2	2	2
GG56C	5							5	5	5	5
GG56D	1							1	1	1	1
GG57B	16							16	16	16	16
GG57C	14							14	14	14	14
GG58A	2						2		2	2	2
GG063						21		21	21	21	21

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
H009C	31							31	31	31	31
H011B		11						11	11	11	11
H011D		27						27	27	27	27
H016						24		24	24	24	24
H017						47		47	47	47	47
H032B		17						17	17	17	17
H033B		11						11	11	11	11
H034B		7						7	7	7	7
H038					14			14	14	14	14
H039						27		27	27	27	27
H049B	7							7	7	7	7
H065								13	13	13	13
H068								54	54	54	54
HH001								67	67	67	67
HH002								93	93	93	93
HH003								116	116	116	116
HH006							104		104	104	104
HH007								22	22	22	22
HH008								9	9	9	9
HH009							22		22	22	22
HH010								41	41	41	41
HH011							46		46	46	46
HH012								34	34	34	34
HH013	3						64		64	64	64
HH014	22						131		131	131	131
HH015								83	83	83	83
HH016								50	50	50	50
HH17B	10							10	10	10	10
HH018				11				47	47	47	47
HH20C		11						11	11	11	11
HH022	8							60	60	60	60
HH023								62	62	62	62
HH025								3	3	3	3
HH028								18	18	18	18
HH029				107				116	116	116	116
HH031				13				33	33	33	33
HH036								21	21	21	21
HH037						5		37	37	37	37
HH038	37							93	93	93	93
HH39B	13							13	13	13	13
HH40B	3							3	3	3	3
HH42B	16							16	16	16	16
HH45D				108				108	108	108	108
HH45E				55				55	55	55	55
I007B					24			24	24	24	24
I007C					21			21	21	21	21
I009D		51						51	51	51	51
I009E		5						5	5	5	5
I014B		59						59	59	59	59
I015		37						37	37	37	37
I017C	19							19	19	19	19
I020B					24			24	24	24	24
I024C	1							1	1	1	1
I024D	4							4	4	4	4
I025C	24							24	24	24	24
I025D	6							6	6	6	6
I028B	2							2	2	2	2

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
I028C	12							12	12	12	12
I029C	6							6	6	6	6
I033B	6							6	6	6	6
I047B	3							3	3	3	3
I047C	11							11	11	11	11
I048B	3							3	3	3	3
I058B	2							2	2	2	2
I058C	3							3	3	3	3
I058D	13							13	13	13	13
I060B	58							58	58	58	58
I061B		12						12	12	12	12
I062C		15						15	15	15	15
I063B				15				15	15	15	15
I063C				3				3	3	3	3
I065A				2				2	2	2	2
I065C				4				4	4	4	4
I070A	11							11	11	11	11
I070C	8							8	8	8	8
I071B	8							8	8	8	8
I071C	2							2	2	2	2
I072C	45							45	45	45	45
I073B	3							3	3	3	3
I073C	36							36	36	36	36
I075B	12							12	12	12	12
I075C	2							2	2	2	2
I080B	12							12	12	12	12
I084B	29							29	29	29	29
I086B	7							7	7	7	7
I088A	11							11	11	11	11
I089B				22			22		22	22	22
I090B	11							11	11	11	11
I096	20							20	20	20	20
I099B	5							5	5	5	5
I099C	1							1	1	1	1
I100C	64							64	64	64	64
I101A	5							5	5	5	5
I102B	3							3	3	3	3
I103C	8							8	8	8	8
I104C	23							23	23	23	23
I104D	3							3	3	3	3
I109B	11							11	11	11	11
I110B	6							6	6	6	6
I111B	8							8	8	8	8
I112B	6							6	6	6	6
I113C	9							9	9	9	9
I121A	3							3	3	3	3
I121B	5							5	5	5	5
I121C	3							3	3	3	3
I122C	13							13	13	13	13
I122D	5							5	5	5	5
I122E	24							24	24	24	24
I123B	35							35	35	35	35
I124B	19							19	19	19	19
I125B	18							18	18	18	18
I126B	14							14	14	14	14
I127	24							24	24	24	24
I128C	16							16	16	16	16

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
I129	30							30	30	30	30
I130	34							34	34	34	34
I131B	27							27	27	27	27
I132B	54							54	54	54	54
I133	19							19	19	19	19
I134B	22							22	22	22	22
I135B	13							13	13	13	13
I136B	2							2	2	2	2
I136C	22							22	22	22	22
I137B	36							36	36	36	36
I138	21							21	21	21	21
I139	25							25	25	25	25
I140B		40						40	40	40	40
J001								69	69	69	69
J002								243	243	243	243
J003								100	100	100	100
J004								73	73	73	73
J005								161	161	161	161
J006								136	136	136	136
J007								35	35	35	35
J008								185	185	185	185
J009								16	16	16	16
J010								17	17	17	17
J011								15	15	15	15
J012								46	46	46	46
J013								72	72	72	72
J014								61	61	61	61
K010C	119							119	119	119	119
K011B	2							2	2	2	2
K011C	15							15	15	15	15
K015B	39							39	39	39	39
K018A	75						75		75	75	75
L001		188						188	188	188	188
L002	92							96	96	96	96
L003		86						100	100	100	100
L005				97				120	120	120	120
L006								116	116	116	116
L007								111	111	111	111
L008								152	152	152	152
L009								66	66	66	66
L010							22		22	22	22
L011							48		48	48	48
L014		155						155	155	155	155
M001C			67					67	67	67	67
M001E			102					102	102	102	102
M001G			182					182	182	182	182
M004B	121							121	121	121	121
M009B	29							29	29	29	29
M010B	29							29	29	29	29
M010D	44							44	44	44	44
M011A	28							28	28	28	28
M012	83							83	83	83	83
M014A	7							7	7	7	7
M014C	9							9	9	9	9
M017B				62				62	62	62	62
M017C				33				33	33	33	33
M020A	19							19	19	19	19

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
M020C	31							31	31	31	31
M024B	156							156	156	156	156
M025								219	219	219	219
N010B		113						113	113	113	113
N019				213				221	221	221	221
P010							61		61	61	61
P011								23	23	23	23
P014	4						255		255	255	255
P019								15	15	15	15
P020								15	15	15	15
P021								149	149	149	149
P022								61	61	61	61
Q002B	248							248	248	248	248
Q002C	10							10	10	10	10
Q002D	3							3	3	3	3
Q003								21	21	21	21
Q004								32	32	32	32
Q005							9		9	9	9
Q006							24		24	24	24
Q007							33		33	33	33
Q008							29		29	29	29
Q009								88	88	88	88
Q010								24	24	24	24
Q011					2			36	36	36	36
Q012	1							61	61	61	61
Q013							23		23	23	23
Q014							24		24	24	24
Q015							46		46	46	46
Q016							75		75	75	75
Q017								73	73	73	73
R001								185	185	185	185
R002				4				92	92	92	92
R003								38	38	38	38
R004	104							121	121	121	121
R005							49		49	49	49
R006								39	39	39	39
R007B				3			3		3	3	3
R007C				16			16		16	16	16
R008							9		9	9	9
R009								19	19	19	19
R011								54	54	54	54
R012							48		48	48	48
R013								41	41	41	41
R014B	65							65	65	65	65
R015								15	15	15	15
R016								38	38	38	38
R017								14	14	14	14
R018	55							124	124	124	124
R019								33	33	33	33
R020								13	13	13	13
R021								21	21	21	21
R022							72		72	72	72
R024							85		85	85	85
R025							174		174	174	174
R026						9		48	48	48	48
R027								60	60	60	60
R028							17		17	17	17

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
R029							10		10	10	10
R030							24		24	24	24
R031							30		30	30	30
R032							30		30	30	30
R033								12	12	12	12
R034								33	33	33	33
R035								68	68	68	68
R036								17	17	17	17
R037						13		132	132	132	132
R038							46		46	46	46
R039	5							10	10	10	10
R046							233		233	233	233
S001							282		282	282	282
S006								32	32	32	32
S007								106	106	106	106
T002								52	52	52	52
T003								78	78	78	78
T004								20	20	20	20
T005								116	116	116	116
T006							461		461	461	461
T007							342		342	342	342
T008							32		32	32	32
T009							47		47	47	47
T010								94	94	94	94
T011								198	198	198	198
T012								71	71	71	71
T013								80	80	80	80
T014								18	18	18	18
T015	14							64	64	64	64
T017	7							45	45	45	45
T019	9							36	36	36	36
T025								71	71	71	71
U003								239	239	239	239
U004		50						50	50	50	50
U005							18		18	18	18
U008								15	15	15	15
U009								48	48	48	48
U010	1							13	13	13	13
U011								24	24	24	24
U012								94	94	94	94
U013								51	51	51	51
U014								5	5	5	5
U015						12		40	40	40	40
U016								28	28	28	28
U018								97	97	97	97
U019								130	130	130	130
U020								51	51	51	51
U021								10	10	10	10
V010B	55							55	55	55	55
V012				88			112		112	112	112
V014B	23							23	23	23	23
V015	32							32	32	32	32
V022B	5							5	5	5	5
V022C	11							11	11	11	11
V022D	11							11	11	11	11
V023B		16						16	16	16	16
V024		237						237	237	237	237

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
W001								51	51	51	51
W002								226	226	226	226
W003								73	73	73	73
W004B	8							8	8	8	8
W004C	4							4	4	4	4
W007								21	21	21	21
X003							20		20	20	20
X011								22	22	22	22
X013B	2						2		2	2	2
X013C	3						3		3	3	3
X014								46	46	46	46
X015								64	64	64	64
X016								26	26	26	26
X017								19	19	19	19
X018								18	18	18	18
X019								73	73	73	73
X020								69	69	69	69
X021								34	34	34	34
X022								19	19	19	19
X023								51	51	51	51
X024								67	67	67	67
X025							12		12	12	12
X026							48		48	48	48
X028							74		74	74	74
X029								70	70	70	70
X031		6						89	89	89	89
X032								82	82	82	82
X033				4				65	65	65	65
X035							67		67	67	67
X036							240		240	240	240
X037								88	88	88	88
X038								17	17	17	17
Y002C	86							86	86	86	86
Y003								23	23	23	23
Y008	3							33	33	33	33
Y009								16	16	16	16
Y010		25						25	25	25	25
Y011		10						10	10	10	10
Y014		23						23	23	23	23
Y015		18						18	18	18	18
Y016		17						17	17	17	17
Y018		47						48	48	48	48
Y019								17	17	17	17
Y020				4				50	50	50	50
Y022			39					39	39	39	39
Y025								69	69	69	69
Y027								31	31	31	31
Y028							6		6	6	6
Y029								52	52	52	52
Y030								143	143	143	143
Y032			33					33	33	33	33
Z004								24	24	24	24
Z006								20	20	20	20
Z007								26	26	26	26
Z008								15	15	15	15
Z011								91	91	91	91
Z012								16	16	16	16

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	DTFC	HERB/SP	PLANT	HERB/REL	PPF
Z013								38	38	38	38
Z014								17	17	17	17
Z015								14	14	14	14
Z016	7							60	60	60	60
Z017								20	20	20	20
Z018								7	7	7	7
Z019								16	16	16	16
Z020								36	36	36	36
Z021	4							43	43	43	43
Z023								15	15	15	15
Z024								50	50	50	50
Z027								88	88	88	88
Z028							137		137	137	137
Z029							32		32	32	32
Z030	18							44	44	44	44
Total	**3,318**	**1,528**	**423**	**925**	**271**	**237**	**5,085**	**20,246**	**25,331**	**25,331**	**25,331**

E.02 NATURAL REGENERATION

Table E.02-1 Alternative 1: Natural Regeneration Treatments

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	HERB/SP	PLANT	HERB/REL	PPF
B001						62	62	62	62	
B002						100	100	100	100	
BB028						162	162	162	162	
BB038		3				25	25	25	25	
BB046						13	13	13	13	
BB055						11	11	11	11	
BB057						28	28	28	28	
BB069						72	72	72	72	
BB072						29	29	29	29	
BB083						94	94	94	94	
CC010						11	11	11	11	
DD016						83	83	83	83	
E008	8					17	17	17	17	
E009						42	42	42	42	
E010						11	11	11	11	
E011						26	26	26	26	
E012						31	31	31	31	
EE013						34	34	34	34	
F007						65	65	65	65	
FF009						61	61	61	61	
FF010						34	34	34	34	
G011						16	16	16	16	
G012					5	5	5	5	5	
G013						5	5	5	5	
G014					176	176	176	176	176	
G015						4	4	4	4	
GG004						7	7	7	7	
GG005						43	43	43	43	
GG006						3	3	3	3	
GG007						65	65	65	65	
GG013						23	23	23	23	
GG022						27	27	27	27	
GG024						75	75	75	75	
GG028						70	70	70	70	
GG029						183	183	183	183	
GG030						13	13	13	13	
GG033						18	18	18	18	
GG035						72	72	72	72	
GG036						28	28	28	28	
GG041	18					49	49	49	49	
GG042		26				26	26	26	26	
GG043	4					26	26	26	26	
GG045						10	10	10	10	
GG046						16	16	16	16	
GG047	2					47	47	47	47	
H038					14	14	14	14	14	
HH022	8					60	60	60	60	
HH023						62	62	62	62	
HH025						3	3	3	3	
HH031				13		33	33	33	33	
HH036						21	21	21	21	
J006						136	136	136	136	

Unit	FB	MA	FB/MA	MP	HC/HP	HC/JP	HERB/SP	PLANT	HERB/REL	PPF
J007						35	35	35	35	
J008						185	185	185	185	
J009						16	16	16	16	
J010						17	17	17	17	
J011						15	15	15	15	
J013						72	72	72	72	
J014						61	61	61	61	
M012	83					83	83	83	83	
P019						15	15	15	15	
P020						15	15	15	15	
Q011					2	36	36	36	36	
Q012	1					61	61	61	61	
R018	55					124	124	124	124	
R033						12	12	12	12	
R035						68	68	68	68	
W001						51	51	51	51	
W007						21	21	21	21	
X016						26	26	26	26	
X017						19	19	19	19	
X018						18	18	18	18	
X020						69	69	69	69	
X022						19	19	19	19	
X023						51	51	51	51	
X024						67	67	67	67	
X029						70	70	70	70	
X031		6				89	89	89	89	
X032						82	82	82	82	
X038						17	17	17	17	
Y003						23	23	23	23	
Y009						16	16	16	16	
Y019						17	17	17	17	
Y022			39			39	39	39	39	
Y027						31	31	31	31	
Y032			33			33	33	33	33	
Z004						24	24	24	24	
Z007						26	26	26	26	
Z012						16	16	16	16	
Z015						14	14	14	14	
Z019						16	16	16	16	
Z023						15	15	15	15	
Total	**179**	**35**	**72**	**13**	**197**	**4,031**	**4,031**	**4,031**	**4,031**	

Table E.02-2 Alternative 3: Natural Regeneration Treatments

Unit	FB	MA	FB/MA	MP	HC/HP	PLANT	GRUB	PPF
B001						62	62	62
B002						100	100	100
BB028						162	162	162
BB038		3				25	25	25
BB046						13	13	13
BB055						11	11	11
BB057						28	28	28
BB069						72	72	72
BB072						29	29	29
BB083						94	94	94
CC010						11	11	11
DD016						83	83	83
E008	8					17	17	17
E009						42	42	42
E010						11	11	11
E011						26	26	26
E012						31	31	31
EE013						34	34	34
F007						65	65	65
FF009						61	61	61
FF010						34	34	34
G011						16	16	16
G012					5	5	5	5
G013						5	5	5
G014					176	176	176	176
G015						4	4	4
GG004						7	7	7
GG005						43	43	43
GG006						3	3	3
GG007						65	65	65
GG013						23	23	23
GG022						27	27	27
GG024						75	75	75
GG028						70	70	70
GG029						183	183	183
GG030						13	13	13
GG033						18	18	18
GG035						72	72	72
GG036						28	28	28
GG041	18					49	49	49
GG042		26				26	26	26
GG043	4					26	26	26
GG045						10	10	10
GG046						16	16	16
GG047	2					47	47	47
H038					14	14	14	14
HH022	8					60	60	60
HH023						62	62	62
HH025						3	3	3
HH031				13		33	33	33
HH036						21	21	21
J006						136	136	136
J007						35	35	35
J008						185	185	185
J009						16	16	16

Unit	FB	MA	FB/MA	MP	HC/HP	PLANT	GRUB	PPF
J010						17	17	17
J011						15	15	15
J013						72	72	72
J014						61	61	61
M012	83					83	83	83
P019						15	15	15
P020						15	15	15
Q011					2	36	36	36
Q012	1					61	61	61
R018	55					124	124	124
R033						12	12	12
R035						68	68	68
W001						51	51	51
W007						21	21	21
X016						26	26	26
X017						19	19	19
X018						18	18	18
X020						69	69	69
X022						19	19	19
X023						51	51	51
X024						67	67	67
X029						70	70	70
X031		6				89	89	89
X032						82	82	82
X038						17	17	17
Y003						23	23	23
Y009						16	16	16
Y019						17	17	17
Y022			39			39	39	39
Y027						31	31	31
Y032			33			33	33	33
Z004						24	24	24
Z007						26	26	26
Z012						16	16	16
Z015						14	14	14
Z019						16	16	16
Z023						15	15	15
Total	**179**	**35**	**72**	**13**	**197**	**4,031**	**4,031**	**4,031**

E.03 Thin Existing Plantations

Table E.03-1 Alternatives 1, 3, 4 and 5: Thin Existing Plantation Treatments

Unit	PF	FB	MA	FB/MA	MP/BURN	HC/HP/BURN
A005	23		23			
A007	22					22
A009	16	16				
A010	14					14
AA01A			80			
AA002	9	9				
AA03A		1				
AA04A		10				
AA04B		5				
AA006	31	31				
AA007	14	14				
AA009	8	10				
AA011	13	13				
AA022	16	16				
AA23A		23				
BB23A		14				
BB039	9					9
BB43A		13				
BB058	10	11				
BB068	13	13				
BB070	32	33				
BB71A		48				
CC001	166		167			
CC003	10	11				
CC004	7					7
CC005	95					95
CC006	66					66
CC007	442	442				
CC008	33	33				
D015	29	29				
DD04A		6				
DD05A					3	
DD009	6	6				
DD012	9					9
E001	45	45				
E002A		50				
E003A		24				
E004	47	47				
E006A		105				
EE001	10	12				
EE03A			2			
EE009	123	123				
EE014	333	333				
EE016	81		81			
EE017	29		29			
F005	24	24				
F006	11	11				
F008	24	34				
F009	7	9				
F010	3	3				
F011	13		13			
GG08A			6			

Unit	PF	FB	MA	FB/MA	MP/BURN	HC/HP/BURN
GG12A						3
GG37A			12			
GG50A		12				
GG51A		40				
GG51C		6				
GG55A		9				
GG56A		14				
GG57A		31				
GG58B		7				
GG061	58	58				
GG062	16	16				
H001	14	14				
H007	40		40			
H008	33	33				
H009A		5				
H009B		37				
H011A			11			
H011C			47			
H014	85		85			
H018	20		20			
H019	12					12
H020	46	46				
H021	36					38
H023	40					40
H024	10	10				
H025	11	11				
H026	8	8				
H027	40					40
H028	39					39
H029	49	49				
H030	29		29			
H031	28		28			
H032A			6			
H033A			1			
H034A			9			
H035	31					31
H036	28					28
H037	28					28
H040	22					22
H041	24					25
H042	34					34
H043	21					30
H044	60					78
H045	18					32
H046	71		80			
H047	14					14
H048	93					93
H049A		40				
H050	28					43
H051	39					46
H052	3					5
H053	17	21				
H054	11	17				
H055	11	24				
H056	24	32				
H057	23	29				
H058	8	15				

Unit	PF	FB	MA	FB/MA	MP/BURN	HC/HP/BURN
H060	10	10				
H061	108	108				
H062	44	44				
H063	52	52				
H064	27	27				
HH17A		11				
HH20A			53			
HH20B			13			
HH021	32		37			
HH39A		27				
HH40A		8				
HH42A		43				
HH45A					122	
HH45B					65	
HH45C					14	
HH046	147	159				
I001	67	67				
I002	80					80
I003	95					95
I004	48	48				
I005	39					39
I006	38	38				
I007A						14
I008	102					102
I009A			13			
I009B			11			
I009C			14			
I010	188					188
I011	32		32			
I012	38					38
I013	18					18
I014A			6			
I016	17	17				
I017A		6				
I017B		44				
I018	18					18
I019	31					31
I020A						11
I021	42					42
I022	62	62				
I023	53	53				
I024A		6				
I024B		9				
I025A		4				
I025B		12				
I026	8	8				
I027	63		63			
I028A		17				
I029A		1				
I029B		2				
I030	39	39				
I031	50	50				
I032	35	49				
I033A		31				
I034	19	19				
I035	17	33				
I036	10	17				

Unit	PF	FB	MA	FB/MA	MP/BURN	HC/HP/BURN
I037	18	18				
I038	17	17				
I039	22	22				
I040	18					18
I042	22	22				
I045	5	5				
I046	49	49				
I047A		9				
I048A		12				
I049	18		18			
I050	26		26			
I051	15		15			
I052	38		38			
I053	79		79			
I054	38	39				
I055	18		19			
I056	7		12			
I057	16	21				
I058A		20				
I059	26	26				
I060A		9				
I061A			4			
I062A			10			
I062B			10			
I063A					17	
I064	36	36				
I065B					6	
I066	57	57				
I067	52	63				
I068	23	45				
I069	92	94				
I070B		28				
I071A		25				
I072A		11				
I072B		5				
I073A		28				
I074	7	7				
I075A		118				
I076	15	15				
I077	34	34				
I078	15	15				
I080A		50				
I081	16	16				
I082	13	13				
I083	42	42				
I084A		9				
I084C		11				
I085	8	8				
I086A		4				
I087	4	4				
I088B		12				
I089A					7	
I090A		18				
I091	63					63
I092	41	41				
I094	34	34				
I099A		15				

Unit	PF	FB	MA	FB/MA	MP/BURN	HC/HP/BURN
I100A		4				
I100B		24				
I101B		20				
I102A		30				
I103A		2				
I103B		11				
I104A		3				
I104B		7				
I109A		16				
I110A		2				
I111A		24				
I112A		7				
I113A		9				
I113B		10				
I114	21	21				
I115	7	7				
I116	41	41				
I117	21	21				
I120	29	29				
I121D		32				
I122A		11				
I122B		6				
I123A		8				
I124A		9				
I125A		4				
I126A		6				
I128A		2				
I128B		2				
I131A		8				
I132A		7				
I134A		6				
I135A		11				
I136A		7				
I137A		3				
I140A			10			
K001	100	130				
K002	210	210				
K003	144	148				
K008	40	40				
K010A		51				
K010B		26				
K011A		14				
K013	123	123				
K015A		49				
K017	12	12				
K018B		170				
M001A				23		
M001B				227		
M001D				108		
M001F				19		
M002	41	41				
M004A		216				
M007	22	22				
M008	150	150				
M009A		16				
M010A		52				
M010C		108				

Unit	PF	FB	MA	FB/MA	MP/BURN	HC/HP/BURN
M010E		58				
M011B		25				
M011C		64				
M013	100	100				
M014B		35				
M014D		5				
M015	28	28				
M016	242	314				
M017A					17	
M018	23	43				
M019	102	118				
M020B		58				
M021	420	452				
M022	27	42				
M023	18	31				
M024A		58				
N009	77	93				
N010A			172			
N011	15					15
N014	189		195			
P002	23					23
P003	33	33				
Q001	175	234				
Q002A		30				
R007A					3	
R014A		6				
U001	10	10				
V003	9		11			
V004	3		7			
V005	7	9				
V010A		2				
V014A		36				
V016	21	45				
V019	36		41			
V020	12	12				
V021	63	69				
V022A		28				
V023A			18			
V027	32	32				
V028	15	29				
V030	42	42				
W004A		2				
W005	5		5			
W006	7		7			
X013A		1				
Y002A		9				
Y002B		6				
Y023	29	29				
Y024	12		12			
Y026	27	27				
Z002	15	25				
Z003	5	7				
Z022	16	16				
Z025	5	5				
Z026	5	5				
Total	**8,487**	**8,720**	**1,720**	**377**	**254**	**1,698**

E.04 DEER REFORESTATION

Table E.04-1 Alternative 1: Deer Reforestation Treatments

Unit	NAT	FB	MP	PF	HERB/SP	PLANT	HERB/REL	PPF
P023					25	25	25	25
P024					43	43	43	43
P025		5			15	15	15	15
P027			25		73	73	73	73
R042B		24		24	24	24	24	24
R042C		7		7	7	7	7	7
R042D		3		3	3	3	3	3
S002A					26	26	26	26
S002B					29	29	29	29
S004A				7	7	7	7	7
S004B				19	19	19	19	19
S004C				22	22	22	22	22
S004D				18	18	18	18	18
S004E	33							
T022A					16	16	16	16
T022B					21	21	21	21
T022C					81	81	81	81
T022D					55	55	55	55
T024A					66	66	66	66
T024B					29	29	29	29
U006					26	26	26	26
U017A					13	13	13	13
U017B					28	28	28	28
Total	**33**	**39**	**25**	**100**	**646**	**646**	**646**	**646**

Table E.04-2 Alternative 3: Deer Reforestation Treatments

Unit	NAT	FB	MP	PF	DTFC	PLANT	GRUB	PPF
P023					25	25	25	25
P024					43	43	43	43
P025		5			15	15	15	15
P027			25		73	73	73	73
R042B		24		24	24	24	24	24
R042C		7		7	7	7	7	7
R042D		3		3	3	3	3	3
S002A					26	26	26	26
S002B					29	29	29	29
S004A				7	7	7	7	7
S004B				19	19	19	19	19
S004C				22	22	22	22	22
S004D				18	18	18	18	18
S004E	33							
T022A					16	16	16	16
T022B					21	21	21	21
T022C					81	81	81	81
T022D					55	55	55	55
T024A					66	66	66	66
T024B					29	29	29	29
U006					26	26	26	26
U017A					13	13	13	13
U017B					28	28	28	28
Total	**33**	**39**	**25**	**100**	**646**	**646**	**646**	**646**

Table E.04-3 Alternative 4: Deer Reforestation Treatments

Unit	FB	PF	HERB/SP	PLANT	HERB/REL[1]	PPF
P023			5	5	7	5
R042B	5	5	5	5	7	5
S002A			5	5	7	5
S002B			6	6	8	6
S004B		4	4	4	5	4
S004D		4	4	4	5	4
T022A			3	3	4	3
T022B			4	4	6	4
T022C			16	16	23	16
T022D			11	11	15	11
T024A			13	13	18	13
T024B			6	6	8	6
U017B			6	6	8	6
Total	**5**	**13**	**88**	**88**	**121**	**88**

[1] HERB/REL (Herbicide Release) acres increase due to founder stand buffers.

Table E.04-4 Alternative 5: Deer Reforestation Treatments

Unit	FB	MP	PF	HERB/SP	PLANT	HERB/REL	PPF
P023				25	25	25	25
P024				43	43	43	43
P025	5			15	15	15	15
P027		25		73	73	73	73
R042B	24		24	24	24	24	24
R042C	7		7	7	7	7	7
R042D	3		3	3	3	3	3
S002A				26	26	26	26
S002B				29	29	29	29
S004A			7	7	7	7	7
S004B			19	19	19	19	19
S004C			22	22	22	22	22
S004D			18	18	18	18	18
S004E				33	33	33	33
T022A				16	16	16	16
T022B				21	21	21	21
T022C				81	81	81	81
T022D				55	55	55	55
T024A				66	66	66	66
T024B				29	29	29	29
U006				26	26	26	26
U017A				13	13	13	13
U017B				28	28	28	28
Total	**39**	**25**	**100**	**679**	**679**	**679**	**679**

E.05 DEER HABITAT ENHANCEMENT

Table E.05-1 Alternatives 1, 3, 4 and 5: Deer Habitat Enhancement Treatments

Unit	Alternatives 1,3,5 **FB**	Alternatives 1,3,5 **HC/HP**	Alternatives 1,3,5 **PF**[1]	Alternative 4 **FB**	Alternative 4 **HC/HP**	Alternative 4 **PF**[1]
P023						20
P026		11	11		11	11
R040	276		276	276		276
R041			404			404
R042A	140		140	140		140
R042B						19
R043	54		54	54		54
S002A						21
S002B						23
S002C			42			42
S003	77		77	77		77
S004B						15
S004D						14
S004E						33
S004F			988			988
S005	52		52	52		52
S008	35		35	35		35
S010			334			334
S011	105		105	105		105
S012	117		117	117		117
S013	100		100	100		100
S014	73		73	73		73
S015	124		124	124		124
T021			73			73
T022A						13
T022B						17
T022C						65
T022D						44
T022E			32			32
T024B						23
T024A						53
T024C			42			42
U017B						22
U017C			63			63
U017D			12			12
Total	**1,153**	**11**	**3,154**	**1,153**	**11**	**3,536**

[1] PF (Prescribed Fire) includes deer reforestation units.

F. Response to Comments

The Environmental Protection Agency (EPA) published a Notice of Availability (NOA) for the DEIS in the Federal Register on November 27, 2015. The 45-day comment period ended on January 11, 2016. CEQ regulations (40 CFR 1503.4) and Forest Service direction (FSH 1909.15, 25.1) require that an EIS responds to substantive comments on the DEIS; and, both allow for a summary of responses with comments pertinent to the same subject aggregated by categories. For the purposes of this EIS for a project subject to comment pursuant to 36 CFR 218, Subparts A and B (1.06 Decision Framework) substantive comments are the same as project specific written comments[10].

In response to the Forest's request for specific written comments, interested parties submitted 34 unique letters including one late letter submitted after the comment period (project record). For tracking purposes, the Forest Service first assigned a unique Letter Identification (LID) number to each letter in the order received (1-34). Next, while reviewing the 34 letters, the Forest Service identified a total of 476 unique comments, assigning a unique Comment Identification (CID) number to each comment (1 to 476). Table F.01-1 lists and identifies the 34 respondents by LID number along with the CID numbers assigned to the comments in each letter.

This Appendix contains the summary comment statements, organized by the 14 general topics shown below. Similar comments are grouped into summary comment statement followed by the CID numbers and a response. Appendix L (project record) includes eight letters submitted by Federal, State and Local Agencies (including elected officials and the Tuolumne Me-Wuk Tribal Council) as comments on the DEIS. The project record content analysis spreadsheet (Comment_Analysis.xlsx) contains all individual comments and identifies specific comments along with the reasons for screening non-specific comments.

1. Climate Change
2. Economy
3. Fire and Fuels
4. Forest Plan
5. Herbicides
6. Invasive Species
7. Natural Regeneration
8. NEPA
9. Reforestation
10. Sensitive Plants
11. Soils
12. Vegetation
13. Watershed
14. Wildlife

CLIMATE CHANGE

1. **Comment**: EPA suggests that the EIS include a more systematic and comprehensive discussion of the impacts of climate change on the project area, and measures to improve the project's adaptability to climate change. For example, consider the increased vulnerability of specific species under a reasonably anticipated climate change scenario, and any projected shift of forest species to more suitable range elevations. We recommend that the EIS discuss measures to improve forest adaptation to climate change, such as the selection of certain species for replanting.

323

Response: UC Davis Adjunct Professor Jim Thorne, modelled climate change conditions within the Rim Fire landscape over the next 85 years. The Forest Service considered that information

[10] Specific written comments. Written comments are those submitted to the responsible official or designee during a designated opportunity for public participation (§ 218.5(a)) provided for a proposed project. Written comments can include submission of transcriptions or other notes from oral statements or presentation. For the purposes of this rule, specific written comments should be within the scope of the proposed action, have a direct relationship to the proposed action, and must include supporting reasons for the responsible official to consider. (36 CFR 218.2)

to formulate site specific treatment prescriptions. Increased temperatures, snowpack decline, drier summers and increased wildfire activity, size and severity are known and predicted effects of climate change to the project area. Large, severely burned portions of the Rim Fire burned area lack sufficient coniferous seed source to reestablish forested ecosystems without reforestation efforts (EIS, p. 7). The effects of climate change was evaluated by each resource including 3.05 Fire and Fuels (p. 117), 3.13 Vegetation (p. 246-247, 263-264) and 3.16 Wildlife (p. 445).The Forest Service recognized that the structure and function of future forests are uncertain due to the effects of climate change (p. 246-247) which will influence future fire regimes and enhance the proportion of early seral habitat on the landscape (p. 246-247). Climate change will also influence plant water balance, mortality, fire risk and microclimate frequency (p. 263-264). The abundance of microclimates in this topographically diverse landscape will contribute to coniferous forest connectivity and enhance the ability of tree species to move and adjust to future climate conditions and disturbances (Groves et. al. 2012). Because of these consequences several things were done to ensure future forests survive and thrive across this landscape; 1) All seedlings will be moved up one elevational band (500 feet) to ensure they are better adapted to the warmer and drier climate; 2) In the majority of the reforestation areas initial planting densities and long-term canopy cover goals were adjusted downward to recognize the greater influence of fire on this landscape; 3) South and southwest facing low elevation slopes were dropped from reforestation activities where the Forest Service identified areas of frequent fire and low conifer potential; 4) More ponderosa pine will be planted because of its tolerance to drought and fire; and 5) Strategic Fire Management Areas (SFMAs) were identified and specific reforestation strategies applied to these areas throughout the Rim Fire. These fuel reduction areas are designed to interrupt fire progression such that the fire reduces in intensity and becomes a surface fire. SFMAs serve to break up the continuity of the vegetation across the landscape and create mosaic patterns. The overall pattern impedes fire spread.

ECONOMY

2. **Comment**: CFA is very interested in seeing as much conifer replanting as quickly as possible in part because of the impact of the Rim Fire on the suitable forest lands that provide wood products for the infrastructure in Tuolumne County. Coupled with the drought-induced mortality, there's a substantial impact to the Forests net annual growth that will be an impact for decades to come.

   18

   Response: The Forest Service considered many similar and opposing comments submitted during scoping on the Proposed Action to identify the Reforestation Method significant issue (EIS, p. 18). Alternatives 3, 4 and 5 address that issue by considering a variety of reforestation activities. Alternative 5 specifically addresses this issue by consistently planting the most trees per acre using a uniform planting pattern (7 by 14-foot spacing) across all reforestation units (p. 37-38).

FIRE AND FUELS

3. **Comment**: Burning within 10 year old plantations where young trees may not be adequately sized and distributed to survive flame lengths up to 3 feet and intensities described in the DEIS (p. 114, 115 and Table 3.05-2), it is possible that over half of the young tree crowns would be scorched and result in immediate and/or eventual tree mortality.

   27 31 79

   Response: Prescribed burning within plantations would only be attempted once modeling showed a high likelihood of success, at which point a small test burn would be conducted to validate modeled results. The goal is to return fire to the landscape within the first 10 years while sustaining the majority of the established trees. Due to the size and topographic diversity of this landscape, conditions advantageous to tree survivability will vary based on site specific conditions and will be evaluated with tree mortality modeling to determine the most appropriate time and place for fire reintroduction. Table 3.05-2 displays a list of fuel models that are expected to be present in the project area over the next 20 years and does not reflect expected fire behavior during prescribed burning operations.

4. **Comment**: After each fire I saw the Stanislaus' reforestation efforts: planting of pines close together; glyphosate to kill the competing vegetation; very little, if any, thinning, by fire or by hand in the succeeding years; and then another fire burning through and the process beginning again. And now you plan to do it all again, in spite of all the evidence that shows that this will simply reproduce the conditions that have exacerbated the fires of the past.

   148

   Response: The proposals within this project are very different from past prescriptions utilized for reforestation on the Stanislaus. The number of trees per acre, the configuration of the planted trees, identification of fuelbreaks and critical fuel areas, the utilization of natural regeneration, the buffers on oaks and meadows and re-introduction of fire at age 10 into these plantations are all unique proposals within this project. In addition, many of the past planted areas were thinned, but not to the ICO structure that has just recently become identified through research (EIS, p. 255-256). Within the Rim Fire the vast majority of high severity fire did not occur in existing Forest Service plantations (p. 255). About two thirds of the older plantations impacted by the Rim Fire survived and are proposed for thinning under this project, so the perception that past reforestation practices and plantation management caused high severity fire is incorrect.

5. **Comment**: The DEIS discussion of the effects of Alternative 3 (p. 120) states that clearing a five foot radius around planted trees will result in removing vegetation on only about 45% of the area which "would likely negatively affect tree mortality, flame length, fire line intensity, and fuel loading." The paragraph concludes with the assertion that these "effects minor within the first 10 years of plantation development." This is not a reasonable conclusion based on the silvicultural literature. Practical experience has shown that roots of brush and other competing vegetation will rapidly occupy the five foot clearance zone causing water stress and increased mortality unless the hand grubbing is repeated several times.

   198

   Response: The EIS (p. 124; 3.05 Fire and Fuels) compares Alternatives 1 and 3 and reflects fire induced mortality to planted trees rather than effects of competing vegetation (i.e., resprouting shrubs). Based on fire behavior modeling and analysis of other wildfires in the area it is anticipated that fire induced mortality would be similar between these two alternatives during the early years of plantation development due to the less combustible nature of young brush and the lack of a significant surface fuel load. Depending on the competing species, more than one grub per year and several consecutive years of treatment would be necessary to meet desired tree survival rates. Implementing this action as planned will reduce fuels in close proximity to planted trees and lessen the degree of unpredictable wildfire related mortality when compared to Alternative 2.

   Utilizing the most current literature, 3.13 Vegetation discusses the mortality of trees from vegetation competition in Alternative 3 (50 to 70%) and Alternative 1 (25%) based on proposed activities for site preparation and release.

6. **Comment**: Landscapes devoid of shrubs are prone to be invaded by non-native grasses and weeds. Grass fuels produce sufficient heat to cause severe scorching in young conifers (Weatherspoon and Skinner, 1995).

   226

   Response: The Forest Service recognizes that non-native grasses have the potential to invade areas treated with herbicides and may contribute to a potential increase in fire frequency (EIS,

p. 120-121). However, management requirements for invasive plants (p. 41, 122) would reduce the likelihood of the introduction of these unwanted species. These recommendations follow the guidelines of the California Invasive Plant Council (http://www.cal-ipc.org/ip/prevention/PreventionBMPs). The EIS (p. 119, 121-122) recognizes the vulnerability of young plantations to fire, regardless of whether the fire is burning in a grass fuel or shrub fuel.

7. **Comment**: YSS believes that long-term success of any reforestation alternative depends upon the pre-planting (site prep) reduction of fuels to less than 20 tons/acre and the protection of all regeneration units with a strategic system of connected fuelbreaks and associated fuel reduction treatments.

457

Response: The Rim Recovery project requires treated areas to reduce the fuel load to less than 20 tons per acre. Additionally, most proposed site preparation activities would further reduce the fuel loading. Each action alternative proposes different types of treatments within Strategic Fuel Management Areas and each one promotes their existence across this landscape.

Forest Plan

8. **Comment**: The 2004 Framework has been rendered inadequate and obsolete by significant new information, and a Supplemental EIS (SEIS), or a Sierra Nevada-wide Cumulative Effects EIS, must be prepared before further logging projects may proceed. The 2004 Framework forest plan was based upon several key assumptions and conclusions about forest ecology and management that have now been refuted or strongly challenged (and the weight of scientific evidence now indicates a different conclusion) by significant new scientific information, which requires a fundamental reevaluation of the plan under NEPA through a supplemental EIS. These issues are bioregional in nature, and are not particular to the analysis area in the project documents; thus, the cumulative effects analysis in the project documents cannot adequately analyze the impacts and cumulative effects of these issues, and a Sierra Nevada-wide EIS must be prepared to address this information and its implications for wildlife species that range throughout the Sierra Nevada mountains. In addition, project-level supplementation would be required for any EA or EIS that is issued pursuant to the 2004 Framework, and that is based upon the Framework's prescriptions and management assumptions/direction, as this project is.

340-431

Response: The 2004 Framework is not an ongoing, agency action. Therefore, the NEPA supplementation regulations (40 CFR 1502.9(c)) do not apply to the 2004 Framework EIS; nor does NEPA require the agency to prepare a "Sierra Nevada-wide Cumulative Effects EIS," as requested.

Even though the Forest Service is not required to prepare a SEIS for the 2004 Framework based on new scientific information, the agency is responsible for considering new information at the project level, when such information is relevant to the project being considered. In this way, new science is addressed at the time and scale that is most relevant and practical.

The Forest Service recognizes that the state of scientific knowledge changed since the 2004 Framework and that Forest Plans should strive to remain consistent with the current scientific understandings. However, it is not practical to supplement programmatic EISs and revise Forest Plans every time new information arises; doing so would lead to an unending loop of programmatic planning. NFMA recognized the need for stability in forest planning, and envisioned that Forest Plan revision would only occur every 10-15 years. The 2004 Framework is now 12 years old, and the Region has begun Forest Plan revision for the Sierra Nevada National Forests, with the first three plan revisions expected to be completed in 2016. It would be impractical for the agency to prepare a new EIS for the 2004 Framework while devoting its resources to revising the plans covered by the 2004 Framework through the current Forest Plan revision process. Until the Forest Plan revisions are completed for the Sierra Nevada National Forests, new scientific information and changed circumstances can be addressed in the site-specific project context, when the new information or changed circumstances are relevant to the project being considered.

The literature provided by The Center for Biological Diversity and John Muir Project was reviewed relevant to the Rim Reforestation project and is available in the project record (Review of Literature submitted by The Center for Biological Diversity and John Muir Project, January 11, 2016).

HERBICIDES

9. **Comment**: It is unclear how the backpack sprayer application will be done. In the cultural resources environmental consequences section (DEIS, p. 109-110), it says backpack sprayers for direct localized application but in the wildlife section (DEIS, p. 348) it says "Glyphosate would be applied via backpack sprayer in a broadcast manner." The SFPUC recommends the following regarding backpack sprayer herbicide applications. Broadcast spray throughout plantations (non-sensitive areas) as needed to control unwanted and competing vegetation. This allows for better tree survival and growth; reduced competing vegetation, even in desired gaps and mosaics; reduced fuel loading; and better meets the project's stated purpose. Spot spray in sensitive areas (e.g., archaeological, sensitive plant, or specific noxious invasive plants). Clearly describe the criteria for various herbicide applications (e.g., broadcast, spot, cut and dab) and the techniques for applying the four different listed herbicides.

77 78

Response: The EIS (p. 21-22) clarifies this language in Chapter 2 under the Noxious Weed and Reforestation sections as well as in the chapters identified the comment. For all reforestation treatments glyphosate would be applied by backpack sprayers throughout the units outside of buffer zones and non-treatment areas such as sensitive plant sites. Spot treatments would be used for all noxious weed eradication. These treatments would apply the chemical only to the targeted plant species minimizing the amount applied and the vegetation effected.

10. **Comment**: One label requirement for Roundup is that it should not be used in or near freshwater to protect amphibians and other wildlife. Blanket spraying of herbicides may also be detrimental to desirable vegetation. Herbicides may irretrievably alter our natural habitat, and in turn, create an unhealthy biodiversity cycle.

186

Response: Roundup is not proposed for use in this project. Glyphosate formulations that are labeled for use in and around aquatic environments (e.g., Rodeo or an equivalent) would be used instead (EIS, p. 533). Glyphosate would be used on just over 20% of each reforestation unit under Alternative 4; therefore, almost 80% of the vegetation in each unit would not be sprayed. Under Alternatives 1 and 5, glyphosate would not be applied within 20 feet of buffered oaks (p. 26, 38); therefore, about 15% of the vegetation within in each unit would not be treated. Additional herbicide exclusions, such as heritage sites and sensitive plant buffers, would increase the proportion of vegetation not treated. Where vegetation has been impacted by herbicide applications, abundant seed stored in the soil, sprouting species that treatments do not completely kill and vegetation not treated in planting exclusions (e.g., oak buffers) would reestablish throughout the plantations within a matter of years (p. 259-260); therefore, herbicides would not irretrievably alter natural habitat or biodiversity.

11. **Comment**: CSERC objects to such a widespread application of glyphosate for health reasons, for concern about ill effects on wildlife, for concern about impacts to sensitive plants, and for the inarguable outcome that such vast amounts of vegetation will be wiped out by 3 to 4 separate

glyphosate treatments. CSERC does not support that intensity of chemical application to kill non-conifer vegetation.

276 306

Response: The Forest Service considered many similar and opposing comments submitted during scoping on the Proposed Action to identify the Herbicide significant issue (EIS, p. 18). Alternatives 3, 4 and 5 address that issue by considering a variety of herbicide and non-herbicide treatments. Alternative 3 specifically addresses this issue by replacing herbicide use for reforestation with more acres of deep tilling and manual release treatments (p. 32-35). The EIS discloses risks to human health (Appendix D), wildlife (3.16 Wildlife), sensitive plants (3.09 Sensitive Plants) and vegetation (3.13 Vegetation).

Aquatic Species (Herbicides)

12. **Comment**: Streams that offer habitat to foothill yellow-legged frog should not have herbicide use within the buffer zone. Streams "known to be occupied" in the past by FYLF should have a wider buffer; an example would be a 250 foot buffer along Grapevine Creek. Any kind of treatment activity should be prohibited within all FYLF buffers. Treatment should also be limited to 50% or less of the buffer within a sub-watershed.

312

Response: SERA risk assessments were used to estimate herbicide risk. Predicted concentrations were below levels capable of directly affecting individual foothill yellow-legged frogs. SERA model runs did not incorporate the project specific management requirement for a 25-foot general no spray zone adjacent to occupied habitat, and a 50-foot exclusion zone for noxious weeds treatment; therefore, it is assumed that actual concentrations would be considerably lower, with a corresponding reduction in risk.

It is recognized that substantial treatments are proposed within 100 feet of foothill yellow-legged frog habitat. The map exercise used to estimate treatment percentage within the 100-foot buffer substantially overestimates the actual disturbance due to the following: a minimum 15-foot equipment exclusion zone is required for all units, existing hardwoods would not be treated, and all existing riparian vegetation would be left intact/untreated, rock outcroppings and other natural features would not be treated and slopes over 35% would be excluded from heavy equipment use. Considering these management requirements, all treatment in combination (e.g., mechanical, hand, prescribed fire) is expected to occur within less than 50% of the 100-foot buffers in most project sub-watersheds , and non-mechanical treatment is expected to occur within less than 50% of the buffers within the majority of sub-watersheds (EIS, p. 95-96). Though Deer Lick Creek and Corral Creek treatment percentages were calculated at 52% and 77% respectively, the GIS exercise did not account for management requirements and untreated areas; therefore, the Deer Lick Creek sub-watershed is expected to drop below 50% treated. Corral Creek could remain above 50% of the buffer treated, particularly for all treatment types in combination; however, a maximum buffer treatment percentage has not been established for foothill yellow-legged frogs. The project hydrology report discloses effects based on Equivalent Roaded Acres (ERA) (p. 325-330). For example, in the Corral Creek sub-watershed, project actions are expected to raise the ERA about 1% (from 22% to a maximum of 23%) for Alternative 1, and up to 4.6% under Alternative 3 (increased mechanical treatment). Most of the ERA total is a result of past management activities (17%) and moderate or high soil burn severity. The 1 to 4.6% (Alternatives 1 and 3) project-related increase in ERA is unlikely to produce effects (e.g., sedimentation) capable of substantially reducing foothill yellow-legged frog habitat quality within the Corral Creek sub-watershed.

13. **Comment**: Scientific studies have shown that Roundup will kill 98% of yellow-legged frog tadpoles within three weeks of exposure and 79% of frogs within one day. It is actually the trade secret protected surfactant that kills them. Other studies have shown mutations during metamorphosis at much lower concentrations of Roundup.

118

Response: Roundup is not proposed for use in this project for this very reason. The SERA Risk Assessment addressed herbicide effects and the model considered herbicide “formulation”, which includes ingredients such as surfactants. Predicted concentrations were below levels capable of directly affecting individual Sierra Nevada yellow-legged frogs, even without consideration of project management requirements. This project would not apply herbicide within 107 feet of suitable habitat, and this species has not been found in project waters; therefore, no herbicide effects to individual frogs are expected to occur (EIS, p. 30, 92, 95).

14. **Comment**: The 50 foot buffer on Eleanor Creek may limit the ability to meet objectives stated for Noxious Invasive Weeds. Currently, Himalaya Blackberry exists in dense concentrations along Eleanor Creek and manual removal methods are not practical.

85

Response: No areas along Eleanor Creek are proposed for noxious weed treatments in this project. Future projects in this area would have to evaluate the need for herbicides to meet weed eradication and show potential impacts to aquatic species. Appropriate buffers and treatment types would be chosen at that time.

Fire and Fuels (Herbicides)

15. **Comment**: Invasion of flammable, non-native grasses and weeds begins a positive feedback loop. Increased flammability increases the chance of ignition. This increases the chance of recurrent fires which increases the spread of grasses and weeds. For example, herbicide treated stands which burned three times had significantly greater grass and forb fuel loads than herbicide-treated stands which burned once (McGinnis et al. 2010). The DEIS indicates that 30 invasive and non-native species are present or found within five miles of the Project area. Eleven of these are considered to have a high chance (76 to 100%) of infesting a new area. Medusahead (*Taeniatherum caput-medusae*), yellow star thistle (*Centaurea solstitialis*), and tocalote (*Centaurea melitensis*) collectively occupy almost 7,000 acres of land. Barbed goatgrass is considered to have a high chance of infesting new areas. Scotch broom, bachelor button, cheatgrass, and Spanish broom were said to be found within the fire perimeter but are not listed with priority or current acreage. The DEIS (p. 127) acknowledges these problems when it states that weeds and grasses such as medusahead, yellow star-thistle, barbed goatgrass, Scotch broom, and others, …change the arrangement of vegetation, the amount of soil moisture at specific times of the year, the amount of fuel available to burn, and how fire behaves (Keeley et al. 2011). These changes in fire behavior often mean that areas that would not ordinarily burn frequently or at a high intensity are now doing so (DiTomaso and Healy 2007). Conifer plantations treated with herbicides to reduce the number of shrubs are still capable of producing heat strong enough to kill trees found within mixed-conifer forests. For example, fire behavior models of conifer plantations treated with herbicides to remove shrub cover found that surface fire intensity would still be great enough to kill most trees because of the conifers’ small size and low crown heights in the first two decades after planting (McGinnis et al. 2010).

220

Response: Non-native grasses have the potential to invade areas treated with herbicides and may contribute to a potential increase in fire frequency (EIS, p. 120-121). However, management requirements for invasive plants (p. 41, 122) would reduce the likelihood of the introduction of these grasses. The EIS (p. 119, 121-122) recognizes the vulnerability of young plantations to fire, regardless of whether the fire is burning in a grass fuel or shrub fuel.

16. **Comment**: We own a sizable area around the Woods Ridge Lookout that was burnt during this event. This area has been harvested, prepared and planting is nearly complete. A considerable investment

has been made to restore the area. We support efforts to reduce the fuel load and control vegetation around our property. Herbicides must be used when possible to promote forest development and reduce the fire hazard.

163

Response: The 2014 Rim Recovery ROD approved fuel reduction and fuelbreak development in this area. Fuels are being treated to attain a fuel loading of less than 20 tons per acre. All action alternatives include strategic fire management prescriptions to facilitate fire management and reduce long-term risk. Alternatives 1, 4 and 5 include herbicide use.

Human Health (Herbicides)

17. Comment: We are still concerned about the effects of the proposed applications of glyphosate on worker health and the birds and other wildlife and food sources for them, especially as the CA EPA's Office of Environmental Health Hazard Assessment has just filed a notice of intent to list glyphosate as a known cancer agent. This action was taken after the International Agency for Research on Cancer (IARC) deemed it a probable carcinogen. The listing, results of this research and new findings by the IARC and the health hazards should be discussed in the final EIS.

4	8	35	117	126	169	178
180	181	275	285	287	466	

Response: Appendix D (Human Health and Ecological Risk Assessment) evaluates the site-specific risks to worker health. The accompanying SERA Worksheet calculations are incorporated into 3.03 Aquatics, 3.15 Watershed and 3.16 Wildlife sections of the EIS. As stated in Appendix D (p. 534-535) “The analysis of the potential human health effects of the use of glyphosate was accomplished using the methodology generally accepted by the scientific community (NRC 1983; EPA 1986). The risk assessment compares doses, based on site-specific herbicide use levels that people might receive from applying the herbicides or from being near an application site with the U.S. EPA’s established reference doses (RfD), levels of exposure associated with various margins of safety. Each type of dose, assumed for workers and the public, was compared to the RfD to quantitatively assess the potential level of concern.” This analysis did not show any substantial health risks to workers, the general public or wildlife. A lengthy discussion pertaining to the International Agency for Research on Cancer (IARC) Monograph Working Group determination that glyphosate should be classified as “probably carcinogenic to humans” (Guyton et al. 2015) can be found in Appendix D (p. 538) . 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. It has been Forest Service practice to defer to the EPA unless there is a compelling reason to do otherwise. At this point, there is no compelling reason to adopt the IARC’s classification since all the technical details are not yet available from IARC and because both the risk assessment for the Rim Reforestation project and the EPA’s analysis would indicate a different conclusion. As stated, a new risk assessment from the EPA is expected later this year which will undoubtedly consider the IARC’s classification. If the EPA accepts the IARC recommendation, then the Forest Service would consider an update to the glyphosate risk assessment and for purposes of existing NEPA documents, such a reclassification would be considered “new information”. This is the same for the State of California EPA’s Office of Environmental Health Hazard Assessment notice of intent to list glyphosate as a known cancer agent. At present the State has not listed glyphosate, but if and when it does, the Forest Service will look at updating the risk assessment to consider “new Information”.

18. Comment: Herbicides are an issue because water from SFPUC watersheds is approved for human consumption. The SFPUC assumes the only approved herbicides for use in this project are the ones listed in the DEIS.

71

Response: Yes, only EPA approved herbicides (glyphosate, clopyralid, aminopyralid and clethodim) are proposed for use in this project.

19. Comment: SFPUC appreciates the herbicide evaluations (e.g., DEIS, p. 317-323, p. 342-357, and p. 529-543). The SFPUC had concerns with two herbicides during scoping: clopyralid because it is associated with substantial reproductive problems and is "persistent" in soil; and clethodim because it has a "Warning" signal word indicating a higher hazard rating than Glyphosate. The DEIS evaluations appear appropriate and the SFPUC does not necessarily oppose either herbicide as long as they are selectively and appropriately applied away from watercourses.

72

Response: The labels for clopyralid and clethodim do not specify a specific distance required for buffering watercourses or aquatic features, but do restrict direct application to water, application where runoff is likely to occur or application when weather conditions favor drift. Management requirements (EIS p. 32) for these herbicides require a 50-foot buffer on all streams, special aquatic features and wet areas that have standing water at the time of application. A 15-foot buffer is required for all intermittent and ephemeral streams and special aquatic features that are dry at the time of application. A 10-foot buffer is required around all obligate riparian vegetation. Additionally, application of cloypralid and clethodim would not occur in areas with high surface runoff potential or soils that are saturated at the time of application. Finally, to reduce off-site movement, drift, or volatilization all herbicides may only be applied during optimal weather conditions (p. 31).

20. Comment: The DEIS inadequately analyzes the potential impacts of herbicides on recreational users, in particular during the summer months. While the DEIS includes several management requirements restricting the use of herbicides based on sensitive species, there is insufficient analysis and mitigation of potential impacts to children and young adults using the forest, in particular, the ones who recreate at Camp Tawonga and the immediate vicinity of the upstream portions of the Middle Fork Tuolumne River. The analysis and mitigation regarding human exposure after application is deficient. Specifically, we informed you that thousands of young children will be swimming and hiking along the riparian corridor of the Middle Fork Tuolumne River which flows directly through Tawonga's private property. As we know from the World Health Organizations recent (2013) publications on the effect of herbicides on children, "Chronic, low-level exposures can affect the skin, eyes, nervous system, cardiovascular system, respiratory system, gastrointestinal tract and liver, kidneys, reproductive system and blood. Recent research has examined the effect that some herbicides may have on the endocrine (hormone) systems of children. Such endocrine disrupting chemicals or Dec's can mimic or inhibit normal hormones, which may affect the physical and neurological development of children and adolescents." This is precisely the risk that concerns us. Our children are not just visiting the Forest for an afternoon--they are living for weeks at a time at Tawonga, swimming in the river and hiking along its shores daily.

134 135

Response: Appendix D (Human Health and Ecological Risk Assessment) analyzed the site-specific risks to human health and ecological risk from using glyphosate. As it specifically relates to the issues raised in the comment, the risk of chronic exposure to the general public is low; especially exposure from contaminated water. Glyphosate is inactivated in soil and water by microbial degradation (EIS, p. 320). Schuette (1998) reported water sampling on the Eldorado National Forest that detected no glyphosate just 2 days after application. The same sampling effort detected no glyphosate in sediment samples taken from water features up to 90 days after application, suggesting glyphosate was not translocated from vegetation to water or sediment. The lack of glyphosate in the water and sediment was attributed to rapid degradation of glyphosate. Studies have estimated that 50% of foliar residues dissipate in about 2 days and 90% in less than 16 days (Schuette 1998). Glyphosate applications under Alternatives 1, 4 and 5 would most likely occur during the months of February through April, which would provide ample time for dissipation before summer activities at Camp Tawonga begin in late May to early June. To further prevent exposure to the general public treatment areas would be inspected prior to application of herbicides to ensure that no one is present who is not officially participating in the application process, access into treated areas would be restricted until the liquid herbicide solution has dried and signs would be posted adjacent to units after application (p. 31). In the event that members of the public were exposed to glyphosate despite precautionary steps taken during application, exposure scenarios with the only hazard quotients of concern include consumption of contaminated vegetation or water exposed to an unrealistically high concentration of glyphosate (p. 544-546); however, these scenarios are unlikely and the probability of longer-term or chronic exposure is less likely.

21. **Comment**: You wish to once again kill the natural succession of vegetation that competes with the seedlings you have planted using glyphosate, a compound whose effects on the environment and animal life are still unknown. All this at a likely cost of millions of dollars, using intensive toxic herbicide applications to kill the natural forest re-growth on the premise that a natural forest can't possibly grow back without such an interruption of the natural ecological processes. This flies in the face off multiple scientific studies, and even common sense, that show that such unnatural intrusions are not necessary.

150

Response: Natural forest succession, like forest structure, can take on many different forms, but is often defined as something “closer to what the condition would be in the absence of human intervention” (Burton and Macdonald 2011, p. 845). As explained by Burton and Macdonald (2011) striving for naturalness is not just spatially complex, but also temporally complex because forest structure is dynamic and has been influenced through time by humans; therefore, setting strategic directions based on our current understanding of ecosystem structure and function is necessary to restore natural processes such as forest succession. While restorative actions are often intrusive and not “natural”, they can incrementally accelerate or move an ecosystem toward a more natural condition than compared to doing nothing (Ibid). The EIS (p. 231-233) outlines goals and direction for restoring forest structure and ecological integrity. The common theme is to promote establishment of dominant ecological characteristics such as composition, structure, function, connectivity, and species composition and diversity. These ecological characteristics are important because their degradation can lead to significant type conversions that result in vegetation and ecological processes different from what historically occurred (Coppoletta et al. 2015; Crotteau et al. 2013; Zimmerman 2003).

The Rim Fire resulted in high severity patches that were uncharacteristically large and accounted for a greater proportion (35%) of the burned area than historically occurred (p. 10). Within these uncharacteristically large patches few if any mature live trees remain; therefore, the natural forest structure that historically promoted abundant natural pine regeneration is lacking (p. 262). For instance, there is now a lack of nearby seed sources and an abundance of shrub cover, which will greatly slow the establishment and development of conifer forest and eventually favor the establishment of fire-intolerant species such as white fir over fire-tolerant species such as ponderosa pine (p. 241-242, 262, 274-275). The use of glyphosate along with planting a historical mix of conifer species will accelerate the establishment and development of a forest that better reflects historic undisturbed conditions. Such forests would have occurred in the project area had natural forest dynamics and ecological processes, such as wildfire, not been disrupted over the last century.

22. **Comment**: Another chemical, clethodim, also sends alarm bells clanging. Quoting your report, “There is a general lack of monitoring data on clethodim in surface water and groundwater. This is a limitation in the risk assessment and a source of uncertainty. But, based on literature review, there is very little risk posed to water quality from this herbicide application. I don’t think that I trust 'literature review' that clethodim poses very little risk. Some studies 'showing' that Round-up is safe were funded by Monsanto (https://www.organicconsumers.org/news/feds-usedmonsanto-funded-studies-decide-monsantos-weed-killer-safe). Our fragile ecosystem can't take that chance; you can't un-ring the bell of environmental disaster. There are other alternatives; safe, non-toxic alternatives.

184

Response: The Forest Service is aware of the lack of monitoring data on clethodim for surface water and groundwater as disclosed in 3.15 Watershed (p. 325). Literature review included a thorough examination of the SERA risk assessment. The SERA assessment report (SERA 2014, project record) utilizes the most recent information and reflects documents released by the EPA's Office of Pesticide Programs' review of Clethodim as well as peer review comments. SERA 2014 (p. 1-5) provides information about the detailed program that the EPA uses for evaluating and classifying herbicide studies. Forest Service risk assessments defer to the most recent assessments by the EPA. The risk to water quality from Clethodim was predicted using the Human Health and Ecological Risk assessment. Potential water quality impacts were assessed based on the probable or reasonably expected concentrations that might be encountered in water following herbicide application as well as a worst case or spill scenario. These scenarios were analyzed and documented in 3.15 Watershed (p. 324-325). The analysis concluded that water contamination is not expected under any of the scenarios. In addition, this herbicide is not expected to contaminate water because the project is only utilizing ground-based applications, the herbicide is short-lived and buffers and other applicable BMPs (2.02 Alternatives Considered in Detail, Table 2.02-4) are in place.

Invasive Species (Herbicides)

23. **Comment**: I note that both Himalayan (*Rubus discolor*) and cut-leaf (*Rubus laciniatus*) blackberry are scattered throughout the burned area of the Rim Reforestation project, including Mariposa County. While these are not high priority target species, their control on some of the infested sites within the project area may be ecologically necessary. For that reason, I would suggest that triclopyr be included in your list of proposed herbicides for woody plant control if at all possible. This herbicide has been used successfully on other projects in the Stanislaus such as the Monotti project.

110

Response: The Forest Service recognizes the effectiveness of triclopyr for controlling blackberries and supports its use under the appropriate conditions, which is why it was considered for use in this project. However, the butoxyethyl ester form of triclopyr which carries the "Caution" label is quite volatile and can drift on warm days to non-target vegetation, potentially causing unintended harm. Triclopyr in the triethylamine salt form carries a "Danger" label, requiring a closed system for mixing under California law and poses a greater health and safety risk. Additionally, triclopyr has a greater risk of off-site movement after a rain event requiring a wider buffer on streams than glyphosate. Since blackberries tend to grow where soil water is ample, such as on the margins of streams or seeps, triclopyr would not be allowed in many of the application sites. The Invasive Plant Management Crew in Yosemite National Park has had excellent results using glyphosate against Himalayan and cutleaf blackberry when applied in late summer to early fall when the plants are pulling sugars back into the root systems in preparation for winter dormancy.

24. **Comment**: Of the 4 herbicides proposed for use in controlling invasive weeds, aminopyralid has "very little information … available … in open literature because it is a new herbicide" (p. 343). It also has one of the longest half-life estimates of 25 - 74 days in the soil in a field setting (p. 202), or 25 -35 days in soil (p. 343). It is unclear why these two different estimates are provided, how they are different, and if one is more accurate than the other. Aminopyralid is more mobile in soil, leading to a greater risk of being translocated and possibly entering groundwater. Of the weeds it is used to control, only two, oxeye daisy and sulphur cinquefoil, are not listed as being effectively treated by clopyralid. Clopyralid is preferable because it is already proposed for use on other weeds, and there is more reliable information about its effects. Oxeye daisy is a high priority weed, but there is less than half an acre of infested area and it is considered a low risk weed. Sulphur cinquefoil is also a high project priority but low risk weed, covering almost 200 acres (p. 124). Removing sulphur cinquefoil, a low risk weed, may lead to infestations of higher risk weeds.

183 317

Response: The Forest Service considered the best available science to inform the analysis of potential impacts from aminopyralid. As noted in the SERA report (2010), aminopyralid is "structurally very similar to both picloram and clopyralid." Information displayed in the SERA report indicates that aminopyralid was developed as a "reduced risk" alternative to some of the more commonly used herbicides like picloram, 2-4D and even clopyralid. Research conducted by California Department of Fish and Wildlife on effects to aquatic species has resulted in a better understanding of possible effects of this herbicide.

The California Invasive Plant Council (Cal-IPC) gives oxeye daisy a moderate rating due to its invasiveness and potential to impact ecosystems (2006). The oxeye daisy occurs in a reforestation unit where site preparation disturbances pose a risk of spread. As the commenter noted, the site is small, 0.04 acre. Eradication of noxious weed infestations is most successful and cost effective when attempted while the infestations are small and relatively new to a site.

Sulphur cinquefoil is a California A-rated noxious weed meaning that it is of the highest concern among weeds, and is subject to state enforced eradication actions. Only one known infestation occurs within the burn area and it is 0.07 acre, far smaller than the acreage stated in the DEIS (182.34 acres) which will make application much easier and likely more effective.

Aminopyralid is selective for a narrow range of species. It will not remove all of the competing species on the site which will reduce the risk of making the area vulnerable to a new weed invasion. The Forest Service is aware of the potential of all of our project-related activities to increase the risk of new weed invasions and has put in place management requirements to minimize this risk.

25. **Comment**: The DEIS acknowledges that not every part of any given acre would actually be sprayed with herbicides. However, it should be understood that those areas which will be sprayed have a significant chance of being invaded by non-native grasses and weeds. This is evident in a study conducted across mixed-conifer forests in Sierra Nevada national forests whereby herbicide-treated stands were found to have significantly greater alien grass and forb cover and species richness (McGinnis et al. 2010). Alien grasses and forbs take advantage of the greater amount of solar radiation on the ground following removal of shrub cover by means of herbicides (McGinnis et al. 2010). Considering the well-known negative impacts of invasive species, the US Forest Service needs to restrict its use of herbicides in ways that will reduce invasive species rather than increasing them.

219 221

Response: The McGinnis study shows that cheatgrass and other non-native grasses and forbs were more prevalent in stands treated with herbicide, allowing for greater solar radiation on exposed soils (McGinnis, p. 29, Figure 5). The study also showed that native forbs and grasses were more abundant as they too responded to increased solar radiation (McGinnis, p. 29, Figure 4). Herbicides in the study were used as a means of limiting competition with planted conifers (McGinnis, p. 25, Section 2.2.3). The study did not mention if there was any follow-up treatment to known weed populations (beyond the initial herbicide treatments to reduce competition from shrubs). This project is also proposing to treat over 5,700 acres of invasive weeds within and adjacent to reforestation units with herbicides. This should help prevent the establishment and spread of undesirable species within this project area. Follow up herbicide release treatments would also likely impact non-native invaders and slow their establishment and spread.

Other factors that affect whether a site is invaded by non-native invasive species include proximity to a seed source (including dormant seeds in the seedbank), presence of vectors to transport the seed to the site and soil disturbance. The Noxious Weed Risk Assessment addresses the possibility of increased invasive plants due to herbicide applications. It shows Alternatives 1 and 5 would have a moderate risk of weed spread, and also allowed for follow-up herbicide treatments, intended to combat known populations of weeds as well as those that may result from spread after site preparation herbicide treatments. Alternative 3 has a high risk of spreading weeds due to a high level of ground disturbance, no indirect benefit of treating weeds through reforestation activities and the use of non-herbicide tools for weed treatments. Alternative 4 has a high risk due to its increased amount of ground disturbing activities, prescribed burning, and non-herbicide tools for weed treatments.

Vegetation (Herbicides)

26. **Comment**: There exists no ecological justification for the use of herbicides on native plants. The proposal to herbicide 16,215 acres of land, as found in Alternative 1, will remove the possibility of natural forest succession for the next several decades in those areas treated and will likely result in significant loss of biodiversity.

218

Response: Historically, 15 to 20% of Sierran mixed-conifer forests existed in an early seral structure (EIS, p. 236). The uncharacteristically large proportion of the Rim Fire that was severely burned has resulted in a much larger proportion of the landscape that is in an early seral structure compared to historic forests (p. 252-255). As a result, the Rim Fire has set large areas of the landscape on a trajectory of forest succession that does not reflect historic post-fire conditions (refer to response to comment 21 for further discussion on natural forest succession). Excluding areas proposed for reforestation would leave between 15 and 20% of the suitable forestland throughout the Rim Fire landscape in an early seral structure that is free to develop without human intervention (p. 271).

The EIS (p. 240-241, 243-245, 262-263, 272-273, 280, and 283) also cites extensive research that observed increased conifer seedling survival and growth when competing vegetation was reduced; therefore, herbicides will accelerate the establishment and development of a mixed-conifer forest that better reflects historic species composition and structure compared to taking no action, which could require greater than 100 years for a forest primarily composed of shade-intolerant conifers to succeed chaparral vegetation across uncharacteristically large portions of the landscape (p. 241-242, 272-275, 288-290). While herbicides would temporarily setback sprouting and seeding species to allow planted seedlings to establish and thrive, naturally regenerating conifers, oaks and riparian vegetation would not be affected and those species targeted would rapidly recover after herbicide treatments stop (p. 259-260). Additionally, portions of each reforestation unit would not be treated with herbicides (e.g., oak buffers, heritage sites and sensitive plant exclusions), which will allow for native vegetation to persist even within reforestation units.

27. **Comment**: The presence of bearclover is a sign of forest health. McDonald and Fiddler (1999) studied the recovery of bearclover (*Chamaebatia foliolosa*) following site preparation and planting of ponderosa pine seedlings. By the end of the study, a majority (69%) of the seedlings survived, while the plant community was dominated by both ponderosa pine and bearclover. Cheatgrass (*Bromus tectorum*) comprised most of the grass population, but was a minor constituent of the plant community most likely due to the presence of bearclover. In addition, the study states in its introduction that bearclover stands occupy areas ranging from small patches to hundreds of acres, excelling in partial shade provided from ponderosa pines and incense-cedars. Therefore, using herbicides on native plants, which thrive under the conditions provided by conifers, does not coincide with a goal of creating an "ecologically healthy and resilient landscape rich in biodiversity."

232

Response: The Forest Service agrees that the presence of bearclover likely results in reduced abundance of grasses, such as cheat grass. Bearclover is an aggressive competitor because it effectively captures available soil moisture and may have alleliopathic properties that limit establishment and growth of other vegetation (McDonald and Fiddler 1999). Various silvicultural techniques, including herbicide applications, have been evaluated to determine their effectiveness in controlling bearclover to improve conifer survival (Tappeiner and Radosevich 1982; McDonald and Everest 1996; McDonald and Fiddler 1999). As described in the EIS (p. 240-241), these studies found that when bearclover was initially reduced to less than 30% cover (as was the case for McDonald and Fiddler 1999), conifer seedling survival ranged between 69% and 73%. However, conifer seedling survival was significantly lower (13%) in areas with greater than 30% bearclover cover initially, which demonstrates the beneficial effects of early herbicide control for establishment of conifer seedlings in bearclover. These seedling survival rates are also similar to local reforestation records, which indicate that herbicide control resulted in an average of 73% conifer survival and 28% to 48% conifer survival in units not treated with herbicides in the first few years after planting (p. 242-243).

Currently, the majority of areas proposed for reforestation experienced high-severity fire (EIS p. 255-257), so there are few if any mature conifers to provide partial shade over patches of bearclover. However, it is unlikely that herbicide control would eliminate bearclover from plantations (p. 243-244, 259-260); therefore, herbicides would accelerate the growth of conifer seedlings (p. 288-290), which would promote development of mature conifer forest with a bearclover understory, such as that described in the comment.

28. Comment: For Manzanita, buckbrush, non-native grasses, bearclover and many other target vegetation species, the use of herbicides to set back or kill those plants will not substantially degrade ecosystem richness and diversity. There will still be great numbers of those highly common, highly competitive plants still surviving where they are not directly sprayed. However, in the midst of, or underneath, or alongside the target plant species there will be countless plant species that are not legitimately targeted as a competitive threat to the tree seedlings or small conifer trees. Whether it is soap root or a succulent or one of countless wildflowers or bracken ferns or so many other native plants that will be directly intertwined with or adjacent to the target brush and groundcover species, glyphosate spraying will effectively kill countless numbers of those vulnerable plants.

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Response: The EIS (p. 32, 42) includes management requirements that protect obligate riparian vegetation, Sensitive Plants, Watchlist Plants and Forest Botanical Interest plants. Additionally, areas excluded from treatment, such as oak, meadow and riparian buffers as well as cultural and botanical sites would reduce the area where herbicides are applied within each unit. Given the abundance of seed stored in the soil and the amount of excluded area within each treatment unit, the diversity of understory plant communities is not at risk of being lost within the project area and can effectively recover and spread throughout treatment areas over time (p. 259-260).

Watershed (Herbicides)

29. Comment: The SFPUC cannot locate in the DEIS any specified minimum herbicide buffers along watercourses. The SFPUC recommends stating that herbicide buffers along watercourses: Shall meet label requirements and any additional site specific restrictions imposed by a trained professional (e.g., California Pest Control Advisor, or USFS Certified Silviculturist with Interdisciplinary Team input). May vary depending (within label requirements) on site-specific conditions, such as a cut and dab application may be appropriate on blackberries immediately adjacent to and within the high water mark of various watercourses within the affected watersheds.

73

Response: Table 2.02-4 lists the requirements for minimum herbicide buffers along watercourses and the need to comply with all label and other applicable legal requirements for herbicide use, cleaning of equipment and disposal of containers.

30. **Comment**: The SFPUC does not object to legal, safe, professional applications with appropriate herbicides near watercourses. Yosemite National Park (Yosemite) applies glyphosate, with SFPUC coordination and consultation, on vegetation along watercourses within the Yosemite affected watersheds. Mitigations include directly applying concentrated glyphosate onto cut stems (e.g., blackberry) near and within watercourses. The SFPUC recommends an integrated pest management program that includes appropriate herbicides (e.g., glyphosate) applied near and within watercourses to better assure reforestation and control noxious invasive weeds.

86

Response: This project proposes the use of an integrated pest management approach as the adaptive management strategy for weed eradication which includes the use of EPA approved herbicides (e.g., glyphosate) as documented in the EIS (p. 21). Minimum buffer zones have been prescribed for the use of approved herbicides along watercourses for weed eradication and reforestation purposes (Table 2.02-4). These buffer zones will minimize any negative effects to water quality from herbicide use while complying with label requirements and applicable laws. Some of the herbicides proposed for weed eradication are not to be used in water. However, glyphosate can be applied on intermittent and ephemeral streams that are dry at the moment of application, meaning that many areas near or within watercourses would be potentially treated.

Wildlife (Herbicides)

31. **Comment**: A 90% loss of Monarch butterflies and severe losses of bee populations can be directly attributed to the use of herbicides and pesticides. Man has done enough damage to this area already, with historic droughts caused by climate change leading to dry high fire hazards and severe bark beetle infestations. The use of glyphosate in this protected National Park is unconscionable.

116

Response: The analysis area includes National Forest and National Park lands; however, treatments are only proposed on the Stanislaus National Forest. Exposure risk, chemical descriptions, surrogate species and types of exposure are discussed in the EIS (p. 344-346). The honeybee is used as a surrogate for terrestrial invertebrates, the western bumble bee specifically for this project (p. 349). The analysis for glyphosate reveals the potential for greater risk of exposure to individuals under the worst case scenario. Since herbicide applications would occur in the early spring before the flowering period for many plants, it is unlikely that these sprayed plants would provide any suitable forage for bees or other terrestrial invertebrates (p. 353). Compliance with Forest Plan and Pollinator-Friendly BMPs for Federal Lands is discussed in the Wildlife BA/BE and Wildlife Report (p. 124-125) and indicates that we have incorporated several management recommendations that would minimize the risk of exposure to pollinators.

32. **Comment**: The DEIS (p. 342-343) attempts to describe a herbicide risk assessment for the toxicological effects for terrestrial wildlife. The description of glyphosate (p. 343) does not mention that the active ingredient is designated as a probable or known carcinogen. Instead, throughout the remaining discussion of exposure scenarios, the document simply provides statistical exposure estimates and the NOAEL thresholds for species.

286

Response: Appendix D discusses carcinogenicity and mutagenicity as it relates to glyphosate (EIS, p. 538-539). Methodologies and rationale used to measure project effects to terrestrial wildlife in the herbicide risk assessment are discussed in detail (p. 344-349).

33. **Comment**: There is very high probability that common wildlife species from rabbits to ground dwelling birds to snails, lizards, salamanders, butterflies, and many other species will frequently contact the wet glyphosate spray and directly absorb it. The claim that glyphosate will be quickly metabolized and excreted from small mammals by the kidneys in the animal's waste may be statistically valid. It does not, however, remove the potential for that animal to suffer in the future from cancer or some other significant health problem as a direct result of that exposure.

288

Response: All data available related to toxicological risk from chronic or longer term exposure to all species considered in this project are disclosed and discussed in the herbicide risk assessment (EIS, p. 344-359). This analysis includes surrogate species representing terrestrial invertebrates, birds and mammals.

INVASIVE SPECIES

34. **Comment**: The DEIS (p. 127) states that "deep tilling under Alternative 1 would expose soil to colonization by weed species, but the associated planting could reduce this effect in the long-term by establishing a canopy to discourage the continued occupation of the site by sun-loving weed species." The canopy required to inhibit the growth and spread of invasive grasses and weeds will not be achieved for several decades. However, montane and mixed chaparral, the plant community the DEIS demonizes, creates such a canopy within the first few years of growth.

217

Response: The effects of taking no action and allowing chaparral vegetation to dominate large portions of the project area are analyzed under Alternative 2. Despite the rapid establishment of chaparral canopy the "risk of noxious weed spread is the highest under Alternative 2" because the "most important factors for reducing the risk of weed spread in the project area are reforestation treatments which re-establish resiliency to noxious weed invasion in conjunction with treatment of known noxious weeds" (EIS, p. 132). The Forest Service recognizes that new infestations of weeds may arise where deep tilling is used for site preparation due to the amount of exposed soil. In addition to soil disturbance, proximity to a seed source (including dormant seeds in the seedbank) and presence of vectors to transport the seed to the site contribute to infestations. The long-term solution of forest canopy cover should work well in combination with the short-term mitigations identified in the project Management Requirements (EIS, p. 41) which would reduce the likelihood of the introduction of these unwanted invasive species. This combined with the proposed eradication of noxious weeds within and adjacent to treatment units should prevent noxious weed spread and the establishment of new populations.

Although montane and mixed chaparral species may effectively shade out noxious weeds, they would also out compete planted conifer seedlings for moisture and lead to very low survival rates. These species will return to these treated units within a couple years after release treatments are complete and conifer seedlings have become established on these sites (p. 259-260).

NATURAL REGENERATION

35. **Comment**: Using natural regeneration is logical and takes advantage of living desirable seed trees and existing conifer regeneration. We encourage follow-through (e.g., monitoring and adaptive management) with any needed reforestation after 5 years post fire (2018).

70

Response: Natural Regeneration units would be monitored five years post-Rim Fire and where insufficient numbers of seedlings are found, follow up reforestation treatments would occur (EIS, p. 21).

36. **Comment**: The 4,031 acres that USFS has designated for "natural regeneration" should be allowed to do just that. Other Rim Reforestation alternatives include bulldozing and replanting this area, which I strongly oppose. This area accounts for less than 2% of the burn area and will provide valuable data that can be applied to future reforestation plans. It would be a virtually cost free method of testing this concept and would reduce the overall budget, allowing funding to be redirected to other efforts.

115 128

Response: Alternatives 1 and 3 include Natural Regeneration. Alternative 4 proposes far fewer acres of reforestation treatments so these areas were dropped. Alternative 5 proposes treating these areas, but waiting until later in the implementation cycle to allow for natural regeneration to occur. Natural regeneration of desired species would be utilized throughout the project area with all the action alternatives and incorporated into the various planting patterns across the landscape depending on where it occurs (EIS, p. 22).

37. **Comment**: We strongly urge the Forest to recognize the difference in priority need between unstocked sites and the well-stocked natural regeneration sites. With uncertainty that the Forest will actually be able to acquire sufficient funding to actually site prep, plant, and release (and possibly do some thinning of) vast areas already identified for planting treatments. We strongly urge the Forest to either adopt a lower stocking level threshold as a trigger for treatment (such as 50 trees per acre before any consideration will be given to intervention and active reforestation management) or to simply recognize that the 4,000 plus acres of Natural Regeneration stands are already well stocked with trees and are already going to produce wood products, wildlife benefits, recreational and scenic benefits, and watershed benefits. The seedlings that succeed in today's drought will be the best to continue the natural regeneration process.

141 240 310 311

Response: The Forest Service agrees that Natural Regeneration units should have a lower priority for treatment compared to areas that are unlikely to naturally establish a desirable density and conifer species mix. Because Natural Regeneration units were identified with a higher potential to develop these characteristics, they would not be considered for artificial reforestation for at least five years post fire (EIS, p. 21). The intent of this waiting period is to allow natural regeneration to occur, but in the event that it is not meeting desired conditions after five years, actions can be taken because they were analyzed within the EIS.

The intent of using 300 trees per acre as the threshold was to help meet desired future conditions; however, the final EIS now reflects planting densities prescribed under each alternative because 300 trees per acre is not desired everywhere (p. 8-12). In contrast, it is also unlikely that a threshold as low as 50 trees per acre would meet the purpose and need. Based on results from the growth modeling for emergency travel routes which plants 152 trees per acre, starting with just one third of the trees as proposed would likely result in less than 20 to 30% canopy cover and less than 2,500 board feet per acre of merchantable standing timber after 50 years; assuming 100% of the trees survive during this time period. It is more likely that some portion of the 50 trees would die during the next several decades, which would result in even lower tree densities and canopy cover. Additionally, low levels of natural regeneration do not reflect historic processes for natural regeneration. Low and mixed-severity fire created light and soil conditions that promoted high densities of conifer regeneration with a large proportion comprised of pine species. Historic observations and research suggests that while mature conifer density was relatively low (11 to 134 trees per acre), conifer seedling and sapling densities ranged between 350 and 4,000 trees per acre (p. 247-248). Therefore, historic conifer regeneration levels were much higher than proposed planting densities and reflect the reproductive strategy of mixed-conifer species, which is to produce high levels of offspring to ensure site dominance over the long-term in light of a wide range of mortality agents.

38. **Comment**: Studies in dry interior conifer forests have shown that one hundred meters between living seed source trees is the approximate maximum distance for successful natural regeneration within the first 75 years post fire (Malone et al. 2015). Yet, areas with a classic mixed-severity fire pattern that are perfect to allow natural regeneration to proceed without disturbance are targeted for reforestation.

208

Response: Regeneration surveys within the project area indicate that density of conifer regeneration significantly increases with shorter distances to seed sources. Figure 3.13-4 shows results similar to that described by Malone et al. (2015) with over 75% of the conifer seedlings within 250 feet of seed sources. The EIS (p. 257-258) also discusses similar findings from Bonnet et al. (2005) which found that seedling establishment was very successful in patches of high-severity that were within about 40 feet of unburned forest canopy, but decreased exponentially toward the center of burn patches. Bohlman (2012) observed a similar trend in the Freds Fire on the Eldorado National Forest. Some areas proposed for reforestation may be small enough to successfully regenerate with conifers because nearby seed sources are present; however, many of these areas had high densities of small trees killed by the Rim Fire and have been or will be treated to reduce fuel loadings (p. 120). As noted in the EIS (p. 239-240, 256), mechanical operations can significantly reduce conifer density; therefore, these relatively smaller units were proposed for reforestation to ensure that they meet the desired conditions identified for the project. Plans may be modified as part of the adaptive management strategy (p. 20) and all desirable natural regeneration will be utilized during planting operations (p. 22). Therefore, if a desirable density and species composition of conifer regeneration is present in these units, no planting would occur (p. 22).

39. **Comment**: We provided four scientific research articles in our scoping comment letter which address the ecology of post-fire landscapes dominated by mixed-conifer and shrub habitats. The topics covered by this research include conifer nutrition facilitated by mycorrhizae interconnected to manzanita (*Arctostaphylos* sp.), shrubs which reduce drought stress, and documented succession of post-fire shrub regeneration leading to forest domination (Horton et al. 1999, Zavitovsky and Newton 1968, Gomez-Aparicio et al 2004, Russell et al. 1998). These papers were not addressed in the Rim Fire DEIS. Consequently, the full range of direct, indirect, and cumulative effects of removing shrubs by means of herbicides, ground tilling, and related release treatments were not analyzed.

213

Response: The Forest Service has considered the four research papers provided by the commenter as well as the subject matter addressed by those papers. Based on the agency's review of those papers and the much larger body of scientific literature, the Forest Service has reached different conclusions than those reached by the commenter. Specifically, the agency believes that the weight of scientific literature indicates that the beneficial effect of shrubs on conifer establishment and growth is overshadowed by the foremost limiting factor: water availability. As noted in the EIS (p. 262-263), "water availability has been shown to override the beneficial effects of improved nutrient availability on tree growth" provided by shrubs. The EIS (p. 238-239, 241-242, 260, 270-271, 278, and 281) cites extensive research that observed increased conifer seedling survival and growth when competing vegetation was reduced (e.g., Balandier et al. 2006; Conard and Radosevich 1982a; Lanini and Radosevich 1986; McDonald and Abbott 1997; McDonald and Fiddler 1995; McDonald and Fiddler 1997; McDonald and Fiddler 2001; McDonald and Fiddler 2010; Oliver 1990; Powers and Ferrall 1996; Stephenson 1990; Stuart et al. 1993; Tappeiner and Radosevich 1982; Zhang et al. 2006). While the agency recognizes that there is room for reasonable minds to disagree on complex scientific issues, the Forest Service believes that the conclusions advanced by the commenter are not supported by the research papers it submitted or the body of scientific literature, as discussed below (and in the EIS).

The study design used by Horton et al. (1999) was developed to specifically control for the presence of mycorrhizae. It did not control for both mycorrhizae and competition for available soil moisture; and therefore, cannot be extrapolated to such a discussion. Horton et al. (1999) observed a beneficial effect in Douglas-fir seedlings growing among manzanita compared to Douglas-fir seedlings growing among a different shrub species that was not associated with mycorrhizae. In contrast, McDonald and Fiddler (2010) describe a study in which Douglas-fir seedlings growing among manzanita produced 9 to 22 times less root biomass than seedlings grown in an area where the same manzanita species was present, but controlled. This study demonstrates the benefit of controlling competing shrubs even when they may be associated with beneficial mycorrhizae.

Zavitovsky and Newton (1968) evaluated the effect of Ceanothus species on nitrogen availability and soil fertility, and how these factors influence Douglas-fir and hemlock seedlings. They found that despite the presence of snowbrush, no significant amounts of nitrogen had been made available to the Douglas-fir and hemlock seedlings; therefore, there was not a significant correlation between conifer seedling weights and total nitrogen in the soils. In summary they state: "existing evidence suggests that the nitrogen-fixation capacity of snowbrush decreases with increasing soil fertility and is of negligible to marginal importance on sites of moderate forest productivity" (Zavitovsky and Newton 1968, p. 1143). The authors also state that although the importance of snowbrush "in managed forestry may be of dubious value on good soils, snowbrush may prove beneficial on infertile soils if judged strictly according to its contributions to fertility" (Zavitovsky and Newton 1968, p. 1143). This implies that the primary benefit is increased soil fertility, which has limited benefits. The authors go on to explain that because of limited water availability, the only benefit snowbrush may provide to establishment of conifer seedlings is "some shading by young snowbrush". The authors further downplay the benefit of shading seedlings by stating, "[a]bundant seed of conifers is the rule, rather than the exception, yet regeneration is typically scanty" (p. 1143). Therefore, the findings of Zavitovsky and Newton (1968) provide yet another example of how the beneficial effects of shrubs on conifer establishment and growth is often overshadowed by the foremost limiting factor, which is water availability.

The study site evaluated by Gomez-Aparicio et al. (2004) was located in Spain. While the climate and ecosystem may have similarities to the Rim Reforestation project area, none of the species investigated occur in the Rim Fire area; therefore, the applicability of this study to the analysis of the Rim Reforestation project is limited at best. This is especially true for two additional reasons. First, as demonstrated in the EIS (p. 238-239, 241-242, 260, 262-263, 270-271, 278, and 281) and in the discussion addressing Horton et al. (1999), there is an abundance of scientific literature demonstrating that the beneficial effects of shrubs on conifer establishment and growth is overshadowed by the foremost limiting factor, which is water availability. Therefore, any benefit from increased soil fertility or protection from solar radiation by shading is inconsequential because shrubs effectively compete with conifer seedlings for water. Second, the study did not control for variability in site conditions. In other words, the methodology described no site preparation or control of shrubs for the "open" study plots; thus suggesting, there is some other environmental variable affecting the suitability of the "open" study site to support vegetation. If not suitable for shrubs, then these "open" sites likely had limited suitability for conifer seedlings, which may have contributed to higher conifer seedling success in the study site with higher shrub cover.

Russell et al. (1998) documented the succession of post-fire shrub regeneration leading to forest domination. The findings from this study are similar to findings of other research cited in the EIS (p. 241-242, 272-276, 285) that documented suppressed conifer seedlings growing among post-fire vegetation (Collins and Roller 2013; Crotteau et al. 2013; Nagel and Taylor 2005; Shatford et al. 2007). Russell et al. (1998) found that successful post-fire establishment of conifers among shrubs required 30 to 50 years and then several additional decades before conifers overtook the site. The EIS (p. 241, 272-276, 285, 288) agrees with the findings of Russell et al. (1998) and acknowledges the long time period required for conifer establishment and development.

40. **Comment**: Research afforded by Saigo (1969) indicates that rodent activities play important contributions to the natural regeneration of ponderosa pines following major disturbances such as fire. Even when considering the ease of visibility for herbivores and competition for water inherent to saplings growing as clumps, the advantages given to pine saplings germinating from rodent caches seem to outweigh the disadvantages (Saigo 1969). Even though we cited this paper in our previous scoping comment letter, and the Rim Reforestation DEIS cited Saigo (1969), these facts are ignored.

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Response: Saigo (1969) studied the role of rodents as secondary seed dispersers in mature, well established ponderosa pine stands that had experienced thinning and prescribed burning; not regeneration following major fire disturbances. In the introduction and methods section, Saigo (1969, p. 7, 46-47) explains that no major fires, other than slash burning following logging operations, had occurred in the study area since the establishment of Forest Service fire protection services. Saigo (1969) goes on to explain that "[m]uch high-density, regeneration, including an abundance of clumped trees, was found in areas where the soil had been "churned" by various vehicles associated with logging" (p. 47). In contrast, Lesser and Jackson (2013) studied regeneration of areas with little to no seed sources. They note that sparse stands "may not support disperser populations, and therefore, the tree species will not benefit from secondary dispersal until a threshold population size has been reached" (p. 387). As this conclusion suggests, the findings of Saigo (1969) may have limited applicability in large and severely burned areas such as those in the Rim Fire that now have few if any live trees. Furthermore, Saigo (1969) notes that "strong regeneration of young ponderosa pine occurs best under an open or semi-open canopy, such as that provided by the well spaced mature trees growing in a natural pattern achieved by periodic fire "thinning" the understory" (p. 79-80). As noted in the EIS (p. 258-259), shrub cover is typically lower following low- to moderate-severity fire because residual conifers provide high-shade that limits development of shrubs. As a result, reduced shrub cover correlates with increased conifer seedling density (Crotteau et al. 2013; EIS p. 256-258). Saigo (1969) also found that the number of successfully established seedlings was considerably low given numerous modes of mortality. Therefore, even if assuming rodents associated with conifer species do effectively disperse conifer seed into large high-severity areas dominated by shrubs, the actual number of seeds that successfully germinate and survive to maturity would likely be low. Additionally, the seedlings would likely be overtopped by shrubs for 20 years or more (Collins and Roller 2013; Crotteau et al. 2013; Russell et al. 1998; Shatford et al. 2007; EIS, p. 241-242, 272, 285).

41. **Comment**: On pages 254-255, the DEIS admits that there are currently 870 naturally-regenerating conifer seedlings per acre, on average, in high-severity fire areas, plus 185 oak seedlings/sprouts per acre. The DEIS then asserts (p. 254) that 70% of the plots in high-severity fire areas had no natural conifer regeneration, and uses this statement to suggest that there are large areas within high-severity fire patches that have no conifer regeneration, and throughout the DEIS the Forest Service hyperbolically suggests that such areas will not regenerate conifers for hundreds of years (but provides no citation to any data source to support this wild exaggeration).

211 327 440

Response: The comment correctly notes that Table 3.13-8 reports an estimated 870 conifer seedlings per acre in high-severity burn areas. As noted in the table footnotes, this value is calculated using only plots with natural conifer regeneration (i.e., it excludes null plots). To provide a more comprehensive overview of conifer regeneration, the overall averages calculated using all plots were added to Table 3.13-8. The overall average conifer seedling density in high-severity areas is 255 seedlings per acre. This value was originally not reported in the DEIS to avoid giving the inaccurate impression that conifer regeneration is well distributed at desirable densities throughout the project area when it is not. Avery and Burkart (2002) explain that while the ability to describe the pattern of seedling distribution using plot-count sampling methods is limited, “plot-count data can be analyzed statistically to aid in interpreting the uniformity of distribution (for example, a small coefficient of variation would indicate relatively uniform distribution, whereas a large coefficient of variation would indicate non-uniform distribution of trees per acre)” (p. 227). In areas proposed for reforestation, the percent coefficient of variation (CV) was 2%, 5%, 10% and 17% for unchanged, low-severity, moderate-severity and high-severity, respectively. This variation in the high-severity areas is a result of there being a high number of null plots as well as plots with high plot-level densities (e.g., many plots that did have conifers present had greater than 20 seedlings per plot which represent more than 1,000 seedlings per acre). The pattern of many null plots and plots with high seedling densities suggests that there are both areas with little to no regeneration as well as areas with moderate to high densities of regeneration. Therefore, conifer regeneration in high severity burn areas is actually the most inconsistent (i.e., non-uniform) compared to lower burn severities (p. 256) and it would be misleading to suggest that regeneration is evenly distributed throughout the project area.

The EIS (p. 256-258) also explains that conifer regeneration tends to be concentrated in higher densities near seed sources, which also indicates that conifer regeneration is not well distributed throughout the project area. As noted in the EIS (p. 258), Bonnet et al. (2005) found that seedling establishment was very successful in patches of high-severity that were within about 40 feet of unburned forest canopy, but decreased exponentially toward the center of burn patches. Bohlman (2012) observed a similar trend in the Freds Fire on the Eldorado National Forest. Results from the regeneration survey within the Rim Reforestation project area exhibited a similar trend (Figure 3.13-4). Therefore, describing seedling density using only the total number of seedlings averaged across a large area would give the inaccurate impression that desirable densities of conifer regeneration are well distributed across high-severity burn areas. In contrast, averaging the seedling density based on the number of stocked plots would provide a more accurate representation of seedling densities where seedlings occur. Moreover, the EIS does not state that the estimated 9,825 acres that are regenerating occur as one contiguous block (or vice versa). While a small proportion of conifer regeneration occurs farther away from seed sources (Figure 3.13-4), it is more likely that it occurs in relatively higher densities near edges of high-severity patches or near small patches of live trees that survived the fire in high-severity burn areas.

Research suggests that secondary succession from shrub-dominated vegetation to conifer forest (especially mature forest) can require longer than 100 years without human intervention. While studies have observed conifer regeneration in high-severity patches (Shatford et al. 2007), seedling density is often lower following high-severity fire than in lower severity burns (Crotteau et al. 2013). Similarly, Russell et al. (1998) reported that successful post-fire establishment of conifers among shrubs required 30 to 50 years and then several additional decades before conifers overtook the site. The findings of Conard and Radosevich (1982b) and Nagel and Taylor (2005) also suggest that development of conifer forest in areas dominated by shrubs is slow and requires well over 100 years in the absence of fire. This slow succession results from a low abundance of conifer seed sources and intense shrub competition that slows the growth of conifer seedlings. Crotteau et al. (2013) found that about 60% of conifer seedlings were overtopped by shrubs 10 years after a high-severity fire in a mixed-conifer forest. Shatford et al. (2007) concluded that following high-severity fire, shrubs would likely overtop and slow development of conifer seedlings for about 20 years, and beyond 20 years, establishment of conifer forest would be unpredictable. Nagel and Taylor (2005) observed white fir seedlings growing among shrubs that had grown only one foot over the span of 30 years. Most importantly, shade-tolerant conifers such as white fir often dominate conifer regeneration following large high-severity fires (Bohlman 2012; Collins and Roller 2013; Crotteau et al. 2013; Shatford et al. 2007), which is an indication that large high-severity fires are causing an ecosystem type shift (Collins and Roller 2013; Crotteau et al. 2013). These findings were discussed in the draft EIS (p. 239-240, 255, 270-276, 283, 288). The final EIS (p. 7, 241-242) includes additional clarifications and scientific literature citations regarding the potentially long time required to naturally regenerate conifers in large high-severity patches.

Upon further review of the trees per acre calculations, the Forest Service found that hardwood regeneration across areas proposed for reforestation averages about 70 seedlings and sprouts per acre, not the 185 stated in the DEIS.

42. **Comment**: On p. 254, the DEIS admits that post-fire logging under the Rim Fire "recovery" logging project reduced natural conifer regeneration by 74%, and the "recovery" project states that nearly all of the post-fire logging is targeted in high-severity fire areas. Therefore, the figures reported in the table on p. 255 of the DEIS, with regard to the 18,736 acres of high-severity fire, are heavily influenced by post-fire logging. The DEIS fails to provide figures for natural conifer regeneration in high-severity fire areas that have not been subjected to post-fire logging. Thus, much of the high-severity fire areas that are currently lacking conifer regeneration are in substantial part the result of the Forest Service's recent management actions, rather than high-severity fire itself.

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Response: It is true that nearly all of the areas proposed for reforestation are proposed for salvage or fuels reduction under the Rim Recovery EIS. The Rim Recovery Vegetation Report (USDA 2014i, p. 14-15) disclosed the potential for mortality or damage to natural conifer regeneration due to salvage activities. NEPA regulations direct federal agencies to consider the impact of a proposed action on the Affected Environment and to consider cumulative impacts in the context of the effect of past and present actions. Disclosing current conditions in light of the Rim salvage operations discloses the reality of the affected environment as it is, based on past and present actions (EIS, p. 58-60). To display some hypothetical amount of natural regeneration in the absence of salvage would provide a misleading (and incorrect) view of the affected environment, which is inconsistent with NEPA.

At the time the regeneration surveys were completed, salvage operations were underway. Therefore, some areas had been salvaged and others had yet to be salvaged. Table 3.13-8 reports the existing conditions of natural conifer regeneration within areas proposed for reforestation at that point in time (i.e., all plot data is summarized together whether having been impacted by salvage logging or not). Values for logged and unlogged plots have been added to Table 3.13-8 and Figure 3.13-4. While plot data do indicate that salvage logging reduced conifer density by 72% (corrected from 74% upon review of calculations), the overall proportion of null plots was minimally impacted by salvage operations. When comparing logged plots to unlogged plots, the proportion of plots without conifer regeneration differed by less than 4%. Therefore, while salvage operations may reduce the overall density of conifer seedlings, it does not appear to significantly change the overall acres with or without conifer regeneration (p. 240, 257). Disclosing the current amount of regeneration after salvage is in no way intended to convey the amount of regeneration in particular locations that would have been there without salvage. The EIS clearly discloses that salvage operations have some negative impacts on natural regeneration (p. 239-240, 257).

The EIS states that "Post-fire conditions assume the Rim Recovery project and Rim Hazard Tree project are fully completed or will be completed prior to Rim Reforestation treatment activities" (p. 231). Therefore, the analysis of natural regeneration in areas treated by the Rim Recovery and Rim Hazard Tree projects should consider conditions that exist after these projects are completed. As such, impacts to conifer regeneration resulting from the Rim Recovery and Rim Hazard Tree projects are discussed in this EIS (p. 239-240, 256-257) and accounted for in the growth modeling used for the effects analysis of each alternative (p. 238-240). For example, Alternative 2 would result in large high-severity areas that have been salvage logged, but not artificially reforested. Therefore, conifer seedling densities of unlogged plots were reduced to reflect the estimated impact of scheduled Rim Recovery and Rim Hazard Tree project work before being entered into the growth models.

43. **Comment**: The Forest Service's misleading claim about natural conifer regeneration in high-severity fire areas is the result of the Forest Service using a tiny plot size – a mere 1/50th of an acre (DEIS, p. 231) – which essentially guarantees that many/most plots will not contain any conifer seedlings, given the clumped distribution of natural conifer regeneration. For perspective, with plot sizes so small, even in a mature conifer forest with about 30 trees per acre (such as some of the open-canopy, mature forests described in the DEIS), most plots of this size, arranged on a grid as the Forest Service did, would contain no trees, leading to the same erroneous claim of large treeless areas. Dr. Hanson, in 2014 and 2015, conducted linear transects through the interior (i.e., farthest into the high-severity fire patches, and greatest distance from low/moderate-severity patch edges) of two of the largest high-severity fire patches in the Rim fire (the patch surrounding Ascension Mountain, and the patch south of Niagara Creek), with plots 2.5 times larger than those used by the Forest Service, and plots spaced by 200 meters. Only unlogged areas in these high-severity fire patches were included in these surveys. Dr. Hanson's findings are presented below. As the data above show, even though the transects ran through the deepest interior portions of two of the largest high-severity fire patches (with high-severity defined as in Miller and Thode 2007, i.e., RdNBR >640), 90% of the plots contained natural conifer regeneration, with plot sizes 2.5 times larger than those used by the Forest Service, and without the influence of post-fire logging. Moreover, the proportion of the natural conifer regeneration comprised of pine species (ponderosa, Jeffrey, and sugar pine) less than 250 feet into the high-severity fire patches was only 32%, while it was 47% 250-1000 feet into high-severity fire patches, and 59% over 1000 feet into high-severity fire patches. Further, for transects conducted in 2015 (transects 3, 4, and 5), in all plots the tallest (fastest growing) conifers were consistently pines in plots with both pines and non-pine conifers.

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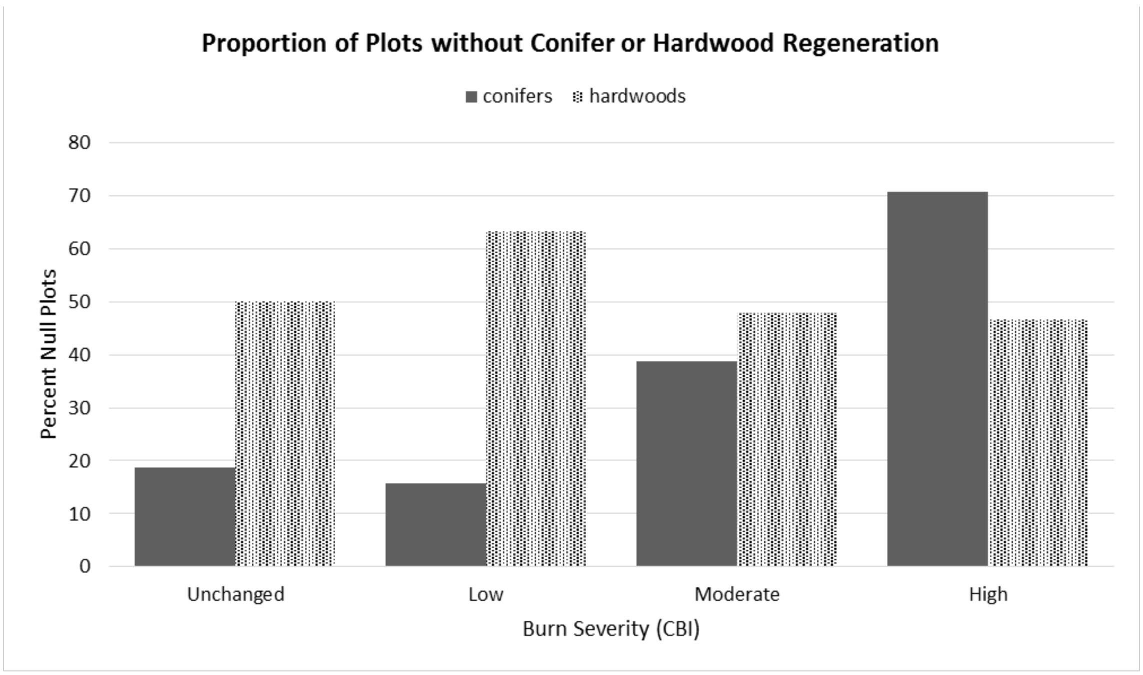
Response: The 1/50th-acre plot size was selected for several reasons. First, plot sizes and sampling methodologies used in scientific literature varied considerably, with many methodologies using plots much smaller than the Forest Service used here. For example, Collins and Roller (2013) used a cluster of three small plots (less than 1/1000th-acre) spaced 200 meters apart and Crotteau et al. (2013) used a cluster of 1/100th-acre plots. In an Expert Report prepared for the United States v. Union Pacific Railroad Company (No. 2:06-CV-01740 FCD/KJM), Hanson (2007) reported using 1/100th-acre plots to assess conifer regeneration within high severity areas of the Storrie Fire on the Lassen National Forest. These plot sizes are considerably smaller than the 1/50th-acre plots used by the Stanislaus and the 1/20th-acre plots suggested as necessary in the comment.

Second, when assessing the spatial distribution of natural regeneration in terms of desired stocking or future stocking, Avery and Burkart (2002) and Matney and Hodges (1991) recommend using a plot size either proportionate to the size of a mature tree or a plot size commensurate with the number of well-distributed seedlings required to achieve desired future stocking. If an area is evenly stocked based on desired tree size and density, then at least one seedling would occur in all or most of the plots. If seedlings are poorly distributed (i.e., clumped), then seedlings would only occur in some portion of the plots. Based on reconstructions of historic tree densities in Sierra Nevada mixed-conifer forests, mature tree densities varied between 11 and 134 trees per acre and sometimes potentially higher (Lydersen and North 2012; Collins et al. 2015; Lydersen et al. 2013; Baker 2014; or see EIS p. 246-249). Determining an appropriate plot size using the standards described by Avery and Burkhart (2002) and Matney and Hodges (1991) would then require a plot size somewhere in the range of a 1/10th-acre to a 1/135th-acre to assess the spatial uniformity of conifer regeneration – 1/50th-acre plots fall roughly in the middle of this range, though toward the larger end of the spectrum.

Third, had most of the 1/50th-acre plots had seedlings in them, then we could conclude that conifer seedlings are well distributed across the high-burn severity areas in such a manner that they might someday develop into at least 50 fairly evenly distributed trees per acre; this was not the case however. Rather, the seedlings typically occurred in high densities on only 30% of the plots. Moreover, the majority of the plots with seedlings occurred in close proximity to seed sources (Figure 3.13-4). If 1/50th-acre plots were too tiny to adequately detect conifer regeneration, then such an obvious trend in the spatial distribution would not be evident because even among higher densities of seedlings the number of null plots would hide such a trend. This point is further demonstrated in the figure below, which compares the proportion of plots without hardwood regeneration to the proportion of plots without conifer regeneration. There is no obvious trend associated with burn severity and the number of plots without hardwood regeneration, which would be expected from tree species that have the ability to sprout; and therefore, do not require nearby seed sources. However, the number of plots without conifer regeneration is far less in the lower burn severities and greatly increases with increasing burn severity. Focusing on only high-severity plots, the overall average conifer density is 255 seedlings per acre, which is 75% higher than hardwood regeneration in high-severity (i.e., 65 hardwood seedlings per acre); yet, there are 34% more plots without conifer regeneration. If the plot size were too tiny to capture conifer regeneration, then it would also be too tiny to capture hardwood regeneration because hardwood density is even lower than conifer density.



Fourth, the issue of plot size also requires consideration of determining an appropriate sampling intensity (i.e., the number of plots needed). A smaller plot size requires more plots to estimate an average to within a desired range (i.e., a confidence interval). In other words, fewer large plots would be needed to estimate the average density of conifer regeneration within a desired confidence interval; however, larger plots provide less insight into the spatial distribution. Therefore, a larger number of smaller plots can provide both an adequate estimate of the average density and help describe spatial distribution. Avery and Burkhart (2002) outline statistical methods for estimating the number of plots of a given size that are required to arrive at an estimate of the mean within a desired confidence interval. When evaluating all plots across all burn severities together with an alpha level of 0.05, the required number of 1/50th-acre plots necessary to estimate the number of conifer seedlings within plus or minus 6 seedlings per acre is 1,684. The Stanislaus completed 1,673 plots in total, which is very close to this number and would more than satisfy an alpha level of 0.1 (i.e., a slightly larger confidence interval). When considering high-severity plots alone using an alpha level of 0.05, 1,165 1/50th-acre plots would provide an estimate of the number of conifer seedlings per acre within plus or minus just 2.5 seedlings. The Stanislaus completed 1,280 high-severity plots (Table 3.13-8), which more than satisfies this confidence threshold.

The importance of sampling intensity can be demonstrated by comparing two separate regeneration surveys conducted by Hanson (2007) and Crotteau et al. (2013). Both studies used 1/100th-acre plots to sample conifer regeneration 7 to 10 years after the Storrie Fire on the Lassen National Forest. Hanson (2007) based conclusions on the results from only 50 plots distributed across 10 study sites (5 plots per site), which suggested there were 380 to 3,300 conifer seedlings per acre with the exception of one site that had only 160 conifer seedlings per acre. Crotteau et al. (2013) based conclusions on a sampling intensity of almost four times that of Hanson (2007). Crotteau et al. (2013) estimated that the overall conifer regeneration density in high severity areas was 287 seedlings per acre, much lower than that estimated by Hanson (2007). Additionally, over half of the high severity study sites sampled by Crotteau et al. (2013) had fewer than 100 conifer seedlings per acre, which suggests a non-uniform distribution similar to that observed in the Rim Fire. These distinct differences between Hanson (2007) and Crotteau et al. (2013) in conifer densities and spatial distribution are quite similar to the differences between the 29 plots installed by Dr. Hanson and the 1,673 randomly located plots installed by the Stanislaus in the Rim Fire. In both cases Dr. Hanson used a much lower sampling intensity, and assuming a random sample was taken, his 29 plots coincidentally landed on areas with high levels of conifer regeneration. While Hanson's data may provide valuable insight into some of the variability of post-fire conifer regeneration, these data should be extrapolated with caution because the low sampling intensity lacks the statistical rigor to accurately describe conifer regeneration with a desirable level of confidence.

Fifth, another benefit of using more, but smaller plots is the fact that the plots can be distributed throughout a greater range of conditions in the project area. While larger plots capture more area in a discrete location, they could potentially bias a sample by limiting the sample units to fewer discrete areas as opposed to distributing them throughout a wider range of conditions occurring in the population. For example, Bohlman (2012) observed high levels of ponderosa pine regeneration following one wildfire, which was considered an exceptional occurrence compared to 15 other study sites where there was little to no ponderosa pine regeneration. Dr. Hanson's small number of 29, 1/20th-acre plots are concentrated in two distinct areas, whereas the Stanislaus distributed 1,673 1/50th-acre plots randomly throughout a greater proportion of the area proposed for reforestation. Therefore, conditions captured by Dr. Hanson's plots may be more representative of a unique occurrence of conifer regeneration and could lead to a misrepresentation of the greater project area if these were the only data considered. For example, Stanislaus plot data identified several large contiguous areas with a disproportionate number of null plots: 23 out of 27 plots in unit S001 (282 acres) were null; 57 out of 71 plots in units T007, T011, T012 and T013 (691 contiguous acres) were null; and, 51 out of 54 plots in units I111B through I140B (492 contiguous acres) were null. While plot locations may not have captured low levels of regeneration that might be present, the large number of null plots suggests that natural regeneration is sparse if present at all in some areas. Additionally, the majority of the conifer regeneration is white fir or Douglas-fir (Table 3.13-8); therefore, many of the areas that do have conifer regeneration would not satisfy the desired conditions for species composition (EIS, p. 8-9, 231-232). Furthermore, at the time of implementation any desirable natural conifer regeneration present would be incorporated into the planting design or skipped over during implementation if a desirable mix and density of conifer species already exist (p. 22).

Sixth, the Forest Service was working with a limited timeframe, budget and number of qualified field technicians, so feasibility of plot size and sampling intensity were weighed from a logistical standpoint. Based on initial test sampling, shrubs that were often tall (2 to 6 feet) and dense caused difficulty locating conifer seedlings that were typically less than 6 inches in height. In the case that large numbers of tree seedlings were present (e.g., several hundred or more), larger plots would increase the likelihood of miscounting seedlings, misidentifying species, and require more time to complete. Errors such as miscounting could propagate into estimates of conifer density, composition and uniformity. Similarly, determining plot boundaries often proved increasingly difficult and inefficient with larger plot sizes; especially when working among vigorous shrub and hardwood sprouts. Based on these limitations and the large project area, 1/50th-acre plots proved efficient while also minimizing field technician error. The time required to complete 1/50th-acre plots balanced well with travel distance between plots, which also permitted more plots to be completed to satisfy the required sampling intensity to achieve the statistical thresholds of confidence. The larger number of plots needed given the plot size also helped distribute the plots across a wide range of locations spanning various site conditions.

Finally, results from Forest Service plot data exhibited similar trends reported in scientific literature. Crotteau et al. (2013) evaluated natural conifer regeneration and shrub cover across a gradient of burn severities in a similar post-fire environment. Despite the differences in their sampling methodology, a similar trend was observed in the project area (p. 256-259). That is, both sampling efforts observed significantly lower densities of conifer regeneration in higher burn severities, a greater proportion of white fir compared to pine species and a greater abundance of shrub cover in higher burn severities. Distance to seed source also followed a similar trend as that observed by Bonnet et al. (2005) and Bohlman (2012), which found decreasing densities of conifer regeneration with increasing distances from seed sources.

NEPA

44. Comment: The term "low site class" is not defined (DEIS, p. 22), although within the context DEIS it appears to indicate "poor soils." To clarify site class determinations, the SFPUC recommends specifying the actual site class or other classification (e.g., Dunning Site Class V, Forest Survey Site Class 7, or grows conifers at less than 20 cubic feet per year).

75

Response: The Forest Service considered both the soil surveys and Dunning Site Class when delineating units; however, the use of the term “low site class” referred to isolated microsites within units that have unsuitable soil conditions for planting conifers and was not meant to describe the productivity of the broader unit. The EIS (p. 22) now describes the intent of that statement.

45. Comment: The Stanislaus identifies the release adaptive management trigger as when greater than 20% of the land is vegetated with grass or shrubs, but also uses the term "free to grow" (DEIS, p.22). The SFPUC recommends using consistent terms and/or defining "free to grow."

76

Response: The EIS (p. 22) now defines the term “free to grow” as when 20% or less of the land is vegetated with competing vegetation.

46. Comment: Oak Buffers. The SFPUC recommends limiting oaks and oak buffers during planting to 5 per acre as described (DEIS, p.26) rather than designating all oaks with buffers (DEIS, p.20).

83

Response: As originally intended, the EIS (p. 26) now describes oak buffers as: “Offset conifer planting 25 feet from the bole of remnant oaks (defined as 8 feet tall and 0.5 inches dbh) or regenerating oak aggregates regardless of topographic position at up to 5 oaks per acre.”

47. Comment: Within the cumulative effects sections throughout chapter 3.16, Wildlife, it is states: "…about 1,583 acres of herbicide application are on private lands in the foreseeable future across the analysis area" (p. 435). However, the appendix states "present land disturbance actions on private lands that are on file with … Cal Fire includes herbicide use on 9,719 acres" (p. 511) AND "reasonably foreseeable land disturbance actions on private lands … include permits for herbicide use covering 5,760 acres" (p. 514). It at first would appear that this difference is due to the limitation of the project action area to about 155,000 acres of NFS lands, but the cumulative effects analysis clearly states that the analysis area is "about 257,000 acres and includes all lands within the Rim Fire perimeter" (p. 341). The total number of acres tied to herbicide use on private lands should be used for the cumulative effects analysis, not the much smaller figure stated in at least 10 places throughout the document.

315

Response: Cumulative effects result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions on Federal or non-Federal lands (40 CFR 1508.7) (EIS, p. 343). Past actions are considered part of the existing condition and are not included in cumulative effects analysis for terrestrial wildlife. In Appendix B, the present land disturbance action (9,719 acres of herbicide application) on private lands occurred in the spring of 2015 and the foreseeable future land disturbance action (3,177 acres out of 5,760 acres of herbicide application) is occurring in the spring of 2016. Therefore, no additive or cumulative effect is expected from herbicide applications that occurred in 2015 or 2016 (12,896 acres of herbicide application) and those proposed under the Rim Reforestation project. Cumulative effects are possible from the 1,583 acres of herbicide application on private lands scheduled for 2017, whose timing overlaps with herbicide applications proposed in this project.

48. Comment: The plan needs to provide a clear and accurate number of acres of private land that have been recently treated or could be treated with herbicides within the geographic and temporal scope of the reforestation plan. It should be made clear why there are 3 different acre figures for herbicide use on private land within the scope of the project and how they are different. The cumulative effects analyses within chapter 3.16 should utilize the accurate number of acres of private land to be treated with herbicides within the analysis area.

316

Response: Same as response to comment 47.

Alternatives

49. Comment: While Alternatives 3 and 4 most closely mirror our ideal approach, the Trust recognizes that none of the alternatives have been documented to best achieve future desired conditions. This reality has been clearly expressed by key Forest Service researchers.

467

Response: The Forest Service and private industry successfully reforested areas within and adjacent to the Stanislaus using similar or higher planting densities than that proposed under Alternative 5. Many of these plantations were thinned, but past thinning prescriptions focused on maintaining low levels of competing vegetation by lightly thinning to an even spacing (unlike the ICO thinning proposed in this project). Despite the higher planting densities and thinning prescriptions used in the past, the majority of the Forest Service plantations impacted by the Rim Fire experienced low to moderate severity fire and contribute very little at all to the overall area that was severely burned (EIS, p. 255-256). As a result of the Rim Fire and the proposed ICO thinning in this project, many of the plantations will have a diversity of individual trees, clumps of various sizes, and openings. The need for herbicides to allow successful establishment and growth of planted seedlings has also been well documented through research (p. 240-241, 243-245, 260, 262-263, 272-273, 280, 283) as well as with experience here on the Stanislaus (p. 242-243). What is not well documented is the implementation or success of “clumpy groupy” planting patterns proposed in Alternatives 1 and 3 or the “Founder Stand” concept proposed in Alternative 4. How these proposals will survive and grow through time as well as their effects on tree and stand structure over time have not been tested.

50. **Comment**: We support a complete and comprehensive reforestation effort that establishes stocking levels at full capacity, controls vegetation and manages plantations over time. Experimental planting methods should be limited to small controlled units and not extended across the landscape. Opportunities for success are greatest during the first attempt and every effort must be made to regenerate this area in a timely manner. Proven successful planting methods must be employed to reduce costs, improve productivity, and gain advantage over competing vegetation. We support the idea of creating "a fire resilient mixed conifer forest that contributes to an ecologically healthy and resilient landscape rich in biodiversity." This objective can only be reached over time following the establishment of fully stocked conifer plantations that can be cultured by land managers to create desired conditions.

162 165 166

Response: Alternative 5 fully considers this reforestation approach (EIS, p. 37-38).

51. **Comment**: Regardless of which approach is chosen we ask that the Forest Service, 1. Reduce the plantation acreage which lacks biodiversity and resiliency to fire. 2. Reduce herbicide use, which carries public health, vegetation diversity, and wildlife risks that threatens landscape biodiversity, by adjusting the cluster planting configuration. The DEIS does acknowledge on page 139 that exposure to glyphosate by birds results in "decreases in food consumption and reduced body weight gain ... " Given the above reports and above action by the CA EPA, choosing an alternative or alternatives that would reduce the use of such herbicides is the prudent action. 3. Reduce practices resulting in sedimentation of the watershed drainages which reduces stream ecological health. 4. Narrow noxious weed activities to reduce land disturbance and resulting sedimentation because it will be impossible to eradicate them anyway because of the limited acreage to be reforested. 5. Reduce the areas proposed for homogenous plantations because of the negative effects on the CA spotted owl. As noted above, studies have shown that California spotted owls select against plantations for foraging and select for complex early seral forests for foraging.

173

Response: The Human Health and Ecological Risk Assessment (EIS, p. 533-549) and the Terrestrial Wildlife Herbicide Risk Assessment (p. 344-359) provide detailed analysis regarding proposed herbicide use and potential effects of the proposed treatments under Alternatives 1, 4 and 5. Decreased food consumption and body weight gain in birds exposed to glyphosate under controlled conditions has been reported; however, these effects are temporary in nature. Field studies do not report adverse effects in birds and effects on bird populations appear to be secondary effects which can be attributed to changes in vegetation (p. 351-352).

A detailed analysis addressing watershed effects including erosion, sedimentation, stream condition and water quality expected under each alternative is available in the EIS (p. 313-340). BMPs would be followed during implementation of each alternative and are expected to minimize project effects under all action alternatives from erosion, sedimentation, stream condition and water quality (p. 338-340).

A range of planting and treatment proposals were analyzed in detail for this project. A wide range of prescriptions, including seven distinct planting designs under Alternative 1 and variable density planting with no specific planting design under Alternative 3, are proposed (Chapter 2.02). Alternatives 1 and 3 propose prescribed fire and Alternative 5 proposes thinning in new plantations (Chapter 2.02). Refer to response to comment 113 for discussion regarding spotted owl use of managed forests. Detailed analysis of predicted effects from proposed treatments to spotted owls, including reforestation is available in the 3.16 Wildlife (p. 371-386).

Spotted owl use of complex early seral habitat is discussed in the spotted owl affected environment section (p. 371-374).

52. Comment: We have identified additional areas of high winter use that are extremely important to deer. These areas include Drew and Jones Meadows and the Gravel Range. The Department recommends these areas be reviewed by the USFS to determine if these areas can be included in the deer habitat enhancement restoration efforts.

254

Response: This project focused specific deer habitat improvement treatments within critical winter range near Jawbone Lava Flat because this area supports the largest concentration of deer within the project area (EIS, p. 136). Treatments within and near the Gravel Range, Drew Meadow and Jones Meadow were not proposed for deer habitat improvement or reforestation efforts based on the oak and shrub component that dominated these areas pre-fire and low quality site capability for restoring conifers. In the future if the need for treatment becomes necessary to support deer in these areas, the Forest could consider a separate project specifically focused on deer habitat enhancement.

53. Comment: The proposed planting buffers for oak trees are adequate for black oak and live oak, but inadequate for blue oaks. We recommend no plantings occur within blue oak stands. If plantings do occur, the buffer around individual trees and/or stands of trees should be increased to a minimum of 50 feet.

258

Response: The 25 foot radius buffer around oaks within reforestation units is based on average crown radius for both black oaks and conifers. The average crown width radius for a 20 inch dbh black oak greater than 80 years old is about 18 feet. (Potter and Johnston 1979, p. 114). Blue oak crown widths are not well documented; however, a champion open grown blue oak documented in Alameda County with a dbh of 77 inches had a crown width radius of 24 feet (McDonald 1990). Sweicki and Bernhardt (1998) found blue oak saplings were most abundant with canopy cover conditions ranging from 20 to 50% and they were uncommon in areas with little or no canopy, indicating that some shade is required for seedling establishment. Most seedlings are found beneath or near the edge of blue oak canopy, not only because most acorns fall in this area, but conditions under the blue oak canopy are favorable for seedling establishment (Ibid). The average crown width radius modeled for a 60 year old conifer is about 8 feet. The two crown radii combined at 60 years is about 26 feet, very close to the buffer we have proposed under Alternatives 1, 3 and 5. Thus, the proposed buffer would provide adequate sunlight and space for regenerating or resprouting black, blue and live oaks.

54. Comment: Reforest more areas denuded by the Rim Fire, insects and drought. We realize that it is likely that budgets will limit the amount of reforestation possible, but the DEIS should at least identify the need, and allow Congress to fund the work if it chooses. An additional reason to increase the area that will be reforested is that Congress through the National Forest Management Act compelled the Forest Service to treat even lands not suitable for timber production for reforestation. The Act requires that "[l]ands once identified as unsuitable for timber production shall continue to be treated for reforestation purposes, particularly with regard to the protection of other multiple-use values." 16 U.S.C. §1604(k). AFRC believes that at a minimum, all lands that are suitable for timber production should be reforested and that unsuitable lands which contained forest before the fire must also be reforested.

161 193 196 199 202

Response: The Forest Service took a hard look at the landscape burned by the Rim Fire and the areas identified in the EIS for reforestation and natural regeneration are those most impacted by the fire and least likely to return to forest cover within the near future on their own. The project area cannot be expanded at this time without additional NEPA; however, future projects may consider the need identified in the comment.

55. **Comment**: Reforest as much of the area west of Cherry Lake as plausible, especially areas with moderate/high burn severity and areas that have numerous dead trees. Reforest the area east of Units N010A and N010B. Reforest the area southeast of Unit N019 in the Wilson Loop area (Road 1N97). Before the Rim Fire, vegetation on Yosemite was dense brush and the USFS plantations had vigorous growing plantation trees with an open grass understory. Subsoiling before planting will help mitigate the existing sheet and rill erosion into Eleanor Creek and help mitigate some of the concerns documented for the Wilson Loop area in the Rim Rehabilitation proposed action. Manage the area north and west of Mather to reduce fire, insect, and disease threats from spreading onto SFPUC managed property. We have concerns with dead large timber near Mather and the lack of harvesting and reforestation.

103

Response: The project area cannot be expanded at this time without additional NEPA; however, future projects may consider the need identified in the comment.

56. **Comment**: The SFPUC appreciates the requirement not to plant within 100 feet of powerlines. Please include these additional requirements specific to reforestation along SFPUC right-of-ways (ROWs): 1) Follow CAL OSHA guidelines for working with boom type equipment (e.g., excavator). 2) No slash piling within the wire zone on the transmission ROW and/or 50 feet of the centerline on the distribution ROW. 3) No mechanical site preparation within 25 feet of guy wires. 4) Contact the Hetch Hetchy Water and Power (HHWP) Right-of-Way Manager in Moccasin when planting near HHWP right-of-ways.

95

Response: These requirements are standard practices that the Forest Service follows during implementation adjacent to power lines. CAL OSHA as well as Federal OSHA regulations that apply to the proposed activities would also be followed during treatment activities.

Alternative 1

57. **Comment**: I feel that employing a broad spectrum of integrated weed management techniques and a sustainable approach to managing invasive noxious weed species that minimizes economic, environmental, and health risks by combining physical, mechanical, cultural, and chemical (herbicide) control will protect both the native plant communities and the wildlife which are negatively impacted by invasive plant species. The impacts of the invasive noxious weed control and eradication contained in Alternative 1 are also beneficial to rangeland vegetation and likely to create a more desirable species composition, improve forage quantity and quality, vegetation condition, and ecosystem function. For these reasons, I support Alternative 1 which utilizes an Integrated Pest Management (IPM) approach for weed eradication which includes burning, targeted grazing, grubbing, and hand pulling in addition to the use of herbicides.

109

Response: The Responsible Official will consider all specific written comments prior to making a decision to select any alternative or a combination of activities from other alternatives (1.06 Decision Framework).

58. **Comment**: We oppose adoption of Alternative 1. The density of proposed plantings continues a decades-long approach of emphasizing wood production over other equally important and legally required forest values. While we understand that the density of proposed plantings are less than has been the norm in recent decades, it is still a level that reduces fire resiliency in the near-term, requires a high level of herbicides to achieve proposed stocking levels. Further, the proposed final stocking levels far exceed the levels recommended by forest service scientists at the reforestation forums, and riskily assumes substantial future funding to conduct pre-commercial thinning to achieve even those proposed stocking levels.

274 284 464

Response: Alternative 1 proposes seven different planting patterns varying by slope position, desired future condition and/or Strategic Fire Management Areas. The maximum number of seedlings to be planted per acre in this alternative is 303. Once oak buffers are factored in the initial planting number drops to 235 trees per acre. Subtract 25% mortality and at year 5 the maximum expected number of trees per acre is 176; almost 100 trees less than desired historic numbers (i.e., 250 per acre). Pre-commercial thinning would not be needed nor is it proposed in Alternative 1. The first thinning would be a commercial thin at age 50 or 60 when tree crowns would finally be closing in on each other and inter-tree competition is beginning to occur (EIS, p. 265-267). When plantations are young (less than 20 to 30 years old), the number of trees has no effect on fire resiliency, nor does the number of trees significantly affect the amount of herbicide needed to control competing vegetation. In addition, tree densities identified by Forest Service scientists and discussed in GTR 220 reflect mature forest structure, not initial planting numbers or young plantation numbers. Naturally regenerating mixed-conifer stands with relatively intact fire regimes would start out with anywhere from 350 to 4,000 seedlings and saplings per acre to eventually achieve 11 to 134 mature trees (p. 346-349).

59. **Comment**: While the majority of the 4,963 acres of invasive weed species (12,174.66 acres when including known invasive noxious weed species populations) in the Rim Reforestation project are located in Tuolumne County, there are still approximately 281 acres of invasive weed species in Mariposa County. Of those 281 acres, approximately 279 acres are infested with yellow star thistle (*Centoureo solstitiolis*) and tocalote (*Centoureo melitensis*). Since 2001, Mariposa County has been working on the control of invasive noxious weeds in the county with both our public and private stakeholders and has initiated a county funded cost share weed control program to control invasive noxious weeds such as yellow star thistle and tocalote on private lands within the county. For this reason, I am particularly concerned about the control of these two invasive noxious weed species during the Rim Reforestation project and hope that they are included in the 5,555.75 acres of invasive noxious weeds to be treated under Alternative 1. In addition, a small area (0.947 acres) of medusahead (*Elymus coputmedusoe*) has been identified within the Rim Reforestation project area in Mariposa County. With such a small area on the Stanislaus National Forest, I would encourage you to aggressively attack and eradicate this species under Alternative 1.

111

Response: The project area cannot be expanded at this time without additional NEPA; however, future projects may consider the need identified in the comment.

Alternative 2

60. **Comment**: We do not support the "No Action" Alternative 2. We prefer forested areas damaged by the Rim Fire to be restored into forested conditions. Many of the units proposed for reforestation either had extremely high severity burn impacts during the Rim Fire, and they now have few to zero young conifers successfully re-growing on the site. Without active intervention and the planting of young conifers, the slow pace of natural reforestation will potentially be delayed much longer due to the extreme distance to existing conifer seed sources and the increasingly hot, dry prolonged summer season. Without active planting of conifer seedlings and active release of the most competitive vegetation in close proximity to the young conifers, vast areas that would be left unplanted in Alternative 2 will not become even sparsely stocked conifer forest again within many decades.

88 295

Response: Alternative 2, the required no action alternative, is considered as a baseline for comparing the action alternatives (EIS, p. 32). Chapter 3 displays the effects of Alternative 2 on the physical, biological, social and economic environments.

61. **Comment**: In reality, "reforestation" or "forest recovery" within the Rim Fire burn landscape involves far more than just sticking tree seedlings in the ground. A "fire resilient mixed conifer forest that contributes to an ecologically healthy and resilient landscape rich in biodiversity" could have very few conifers planted within that landscape and yet meet the overall purpose of the Rim Reforestation project as written in the DEIS (p. xiii). Without any action at all by the Forest Service, a significant percentage of the 21,300 acres planned for conifer planting will already end up with some number of conifers growing successfully to maturity amidst oaks, other hardwoods, brush species, groundcovers, ferns, wildflowers, and a wide variety of forbs – even if the Forest Service does nothing to actively reforest the high severity burn units within that 21,300 acres. So reforestation and the gradual recovery of an ecologically healthy and resilient landscape rich in biodiversity is NOT necessarily dependent upon planting millions of conifer seedlings with a reforestation program based on chemical treatments. "Reforestation" as envisioned by the Stanislaus Forest is actually a more narrow focus tied to planting a dense stocking of conifer seedlings in areas where high severity burn effects significantly reduced conifer survival.

263

Response: Alternative 2 fully considers the forest recovery that would occur without planting a single seedling (EIS, p. 32, 272-279). Conifer regeneration is limited and disproportionately comprised of white fir and Douglas-fir (Table 3.13-8). Research evaluating forest succession following a similar uncharacteristically large wildfire on the Lassen National Forests suggests that "The lack of sufficient Pinus spp. densities after High-severity fire in the Mixed Conifer and Low-elevation Fir forest types is alarming as the reduction in pine may result in an ecosystem type shift" (Crotteau et al. 2013, p. 109). While taking no action may result in a proportion of the project area naturally regenerating with conifer, it is unlikely that future conifer species composition will reflect historic species composition. This shift in species composition combined with climate change may contribute to patterns of high-severity fire that result in large portions of forest becoming locked into cycles of repeat high-severity fires that prevent development of pine-dominated mixed-conifer forest that is maintained by frequent low and moderate severity fire (p. 274-275).

62. **Comment**: There are many species that have their habitat conditions restored by fire disturbance events, especially in the more severe parts of the fire. The needs of many fire-dependent species (species that are nearly restricted to burned forest conditions) are simply not addressed in the Rim Fire DEIS. Given that the USFS is legislatively mandated to maintain the ecological integrity of forest systems that sustain us all, I strongly recommend the No Action alternative to the Draft EIS (DEIS) for the proposed "Rim Reforestation" (Project).

471

Response: The EIS (p. 442-452) includes in depth analysis of direct, indirect and cumulative effects for black-backed woodpecker, a species that relies heavily on burned forest. The MIS Report also includes in depth analysis of direct, indirect and cumulative effects to habitat (i.e., snags in burned forest). The black-backed woodpecker is the designated MIS species representing snags in burned forest also known as complex early seral habitat. The alternatives considered in detail include retention of complex early seral habitat on NFS lands ranging from 8,066 acres (Alternatives 1, 3 and 5) to 10,326 acres (Alternatives 2 and 4). Although 2,260 acres could be impacted under some of the action alternatives, Management Requirement (21(g)) prohibits removal of snags within these units until 2021, eight years post-fire (p. 43). An additional 17,500 acres of complex early seral habitat has been retained in Yosemite National Park which is within the analysis area. These retention areas would continue to provide habitat to fire dependent species.

Alternative 3

63. **Comment**: We do not support Alternative 3. Without herbicide use, increased conifer seedling mortality will occur and surviving seedlings will have reduced growth because of the tenacity of some of the shrub components within the Rim Fire perimeter (particularly bearclover, deerbrush and manzanita). The hand treatments prescribed in Alternative 3 will not be effective and certainly not economic. Along with reduced reforested areas, fewer invasive plants can be treated. The lack of herbicides significantly reduces treated acres and does not meet the USFS stated goals and objectives.

16 89

Response: The Forest Service considered many similar and opposing comments submitted during scoping on the Proposed Action to identify the Herbicides significant issue (EIS, p. 18). Alternatives 3, 4 and 5 address that issue by considering a variety of herbicide applications. Alternative 3 specifically addresses this issue by not using herbicides (p. 32-34), while Alternatives 1 and 5 addresses the use of herbicides (p. 24-32, 37-38).

64. **Comment**: Alternative 3 would not allow any herbicides to be used. Herbicides are dangerous for wildlife, water quality, and the workers who apply the herbicide. Instead, local workers could be hired to remove unwanted plants by hand. This would be a benefit to the local economy as many people would be needed. Sensitive species, such as the foothill yellow-legged frog will thrive in herbicide-free streams.

120 123 125 127 177 185 187
188

Response: The Forest Service considered many similar and opposing comments submitted during scoping on the Proposed Action to identify the Herbicides significant issue (EIS, p. 18). Alternatives 3, 4 and 5 address that issue by considering a variety of herbicide applications. Alternative 3 specifically addresses this issue by not using herbicides (p. 33-34).

65. **Comment**: I am in strong support of Alternative 3. As the US Forest service report highlights, there has historically been numerous wildfires within the geographical area of the Rim Fire. The strategy of alternative 3 would incorporate clumps of less dense plantings and natural fire breaks to better fight wildfires and also support more diverse wildlife.

114

Response: The Forest Service considered many similar and opposing comments submitted during scoping on the Proposed Action to identify the Reforestation Method significant issue (EIS, p. 18). Alternatives 3, 4 and 5 address that issue by considering a variety of planting patterns and densities both within and outside Strategic Fire Management Areas (p. 24-38).

66. **Comment**: The supposed purpose of Alternative 3 was to provide consideration of an alternative that did not utilize significant amounts of herbicides. The strong concern over herbicide use came primarily from CSERC and others in the environmental community who were especially clear in advocating concern about applying chemical treatments on national forest lands. Unfortunately, while a “no herbicide” requirement was made a key part of Alternative 3, other aspects of Alternative 3 make it undesirable for those with environmental concerns. The planting as proposed is a far higher density than recommended by the majority of those who will be seen as “no herbicide” advocates, with trees proposed to be planted at 10 to 14 feet apart. Furthermore, Alternative 3 as described in the DEIS becomes infeasible because, as described, it would result in hand release treatments as often as twice a year over multiple years over a five year period. Such repetitive grubbing and scalping treatments, including twice in a single year, would be too expensive and administratively difficult to implement at such an intensive, repeated level.

297

Response: Alternative 3 does not propose to plant trees 10 to 14 feet apart. The initial planting density prescribed under the variable tree planting strategy and within Strategic Fire

Management Areas for Alternative 3 would result in 152 to 514 trees per acre distributed across units in clumps of different sizes as well as individual trees (EIS, p. 33-34). As noted in the EIS (p. 33), the desired variable densities would reflect slope position and fuels emphasis areas as identified in Alternative 1; therefore, density and spacing between clumps would vary with the topography and landscape position. This planting density also took into account expected seedling mortality as well as oak buffers to ensure adequate conifer stocking to achieve desired future conditions (1.03 Purpose and Need). Past reforestation experience on the Stanislaus has shown that manual release treatments resulted in much lower conifer survival compared to herbicide release treatment (p. 242-243). After accounting for oak buffers and assuming 50% seedling survival, seedling densities are expected to range between 59 and 199 trees per acre (p. 34). By age 60, assuming prescribed fire at age 10 kills no conifers and no major disturbance events occur, tree densities are estimated to range between 38 and 162 trees per acre which is similar to historic estimates of mature mixed-conifer stand densities (p. 246-249, 279-280).

As many as two manual release treatments were prescribed per year because it is well documented that competing vegetation, especially bearclover and other sprouting shrubs, rapidly recover after aboveground portions of the plants have been killed (p. 244-245). For example, bearclover has been documented to aggressively recover within the same year even after a single herbicide application (Tappeiner and Radosevich 1982). The Forest Service recognizes that two manual releases may not be required every year. For instance, some areas may require two releases the first year and only a single release in subsequent years, while another area may require two releases every other year. The response of competing vegetation is expected to vary depending on both site conditions and climate, which make it nearly impossible to prescribe adequate release treatments as narrowly as once per year and within specific years; therefore, to ensure sufficient and realistic flexibility for successful implementation, a worst case scenario was analyzed (just as with herbicide applications) based on research and local knowledge to ensure desired conditions would be met.

67. **Comment**: For reasons tied to health risks of glyphosate exposure to vulnerable plant species and to vulnerable wildlife species, CSERC strongly emphasizes that the safest, most ecologically sensitive alternative for reforestation would be to choose Alternative 3, the No Herbicide Alternative, or to choose a modified version of that Alternative that would limit herbicide spraying solely to sites that contain bearclover.

268 279 292 298 299 318

Response: The Forest Service considered many similar and opposing comments submitted during scoping on the Proposed Action to identify the Herbicides significant issue (EIS, p. 18). Alternatives 3, 4 and 5 address that issue by considering a variety of herbicide applications. Alternative 3 specifically addresses this issue by not using herbicides (p. 33-34).

Alternative 4

68. **Comment**: We do not support Alternative 4 with its significantly few treated acres (e.g., thousands of acres would remain unplanted). The reintroduction of fire required in Alternative 4 poses a considerable risk. Fire as a management tool is generally acceptable but the Rim Fire Salvage effort retained an excessive amount of large woody debris. The horizontal and vertical fuel arrangement is unprecedented and will create control issues. This alternative is impractical due to the risk to plantations and adjacent properties.

90 164

Response: In areas approved for treatment under the 2014 Rim Recovery ROD the fuel loading is anticipated to be less than 20 tons/acre post treatment while still retaining 4 to 6 of the largest snags per acre for wildlife habitat. These snags are not expected to contribute significantly to the fuel load due to their varied distribution throughout the treatment units. If Alternative 4 is selected, areas outside the Recovery project will be treated through site preparation prior to the reintroduction of prescribed fire.

69. **Comment**: Since there is substantial public interest in continued experiments with other methods of conifer and shrub maintenance than that prescribed in alternatives 1 and 5, we believe there is likely some benefit of having a portion of the landscape treated in accordance with Alternative 4. There has been ample experimentation for decades that have shown that prescribed fire alone will prove not to be an effective treatment. However, there is substantial sentiment that prior experiments were not fully carried out and the treatments needed were not done in a timely manner and therefore did not fully implement the experiment.

Given the combination of climate change/drought and the propensity for this Rim Fire landscape to burn periodically at moderate to high severity, it is unclear as to whether or not the unplanted 80% of each reforestation unit will eventually become forested in future decades, or if instead those areas will simply be allowed to be converted into brush and oak stands. If there was even the slightest possibility of having a deficit or a lack of chaparral or oak dominated stands within the Groveland District and Mi-Wok District areas, there might be a benefit to letting 80% of reforestation acres convert to chaparral/oak. However, for years we have worked to help restore forest habitat suitable for the California spotted owl, goshawks, fishers, martens, pileated woodpeckers, and northern flying squirrels. Given that suitable habitat for those species has been significantly reduced over recent decades, we believe that it would not be appropriate to apply Alternative 4 to the entire reforestation area (with only 20% of the total area being replanted). That would diminish the potential for suitable mature forest habitat to regrow quickly on the high severity burn sites compared to an alternative that would plant some pattern of conifer seedlings across the entire 21,300 acres to be reforested.

17 302

Response: Chapter 3 displays the effects of Alternative 4 on the physical, biological, social and economic environments. Specifically, 3.13 Vegetation and 3.16 Wildlife display the effects similar to those described in the comment regarding vegetation and wildlife.

70. **Comment**: Given the significantly lower cost of implementing Alternative 4 vs. any of the other action alternatives, you would be able to implement Alternative 4 over a much larger proportion of the landscape if budgetary shortfalls are realized. In a world of budgetary uncertainty, Alternative 4 is your best chance to meet a stated need for action, "Return mixed conifer forest to the landscape." Not to mention, the capital lost due to an ill-timed wildfire burning a reforested unit under the proposed action is much greater than it would be under Alternative 4. It best responds to a goal of allowing natural processes to dominate and shape recovery within the burned landscape, with assistance from reforestation action by limiting conifer seedling planting to be done only in small variable-shaped planted areas. Compared to the proposed action, Alternative 4 is an ecologically-informed approach to actively manage high severity post-fire forests that minimizes ecological impacts and economic costs. We encourage you to select Alternative 4, but ask that you prioritize the use of hand and mechanical methods to control competing native vegetation in planted areas.

139 145 172 238 244 247 301

Response: Given the uncharacteristically large size and severity of the Rim Fire, natural forest succession as represented by historic reference conditions is unlikely to occur across large portions of the landscape (refer to response to comment 21 for further discussion on natural succession). Compared to the other action alternatives, planting only 20% of the areas proposed for reforestation would contribute the least to restoring a more natural and ecologically resilient mix of conifer species (EIS, p. 283-284). Alternative 4 would also require at least 40 to 60 years before the founder stands reached an age at which they would begin to provide a viable seed source for expansion of desirable conifer species (p. 284). As a result, an uncharacteristically large proportion of the Rim Fire landscape would persist as shrub and oak dominated vegetation for at least the next several decades and likely longer (p. 285-286). While Alternative 4 represents the lowest-cost alternative (excluding Alternative 2), it would provide almost three to four times less present net benefit compared to Alternatives 1 or 5 (p. 191-192). Additionally, Alternative 4 would create far fewer jobs in the local economy than any of the other action alternatives (p. 191).

71. **Comment**: In conclusion we ask you to select Alternative 4. If another alternative is chosen please incorporate these changes: 1) Lower the maximum number of trees planted on any site to 150 trees per acre. 2) Reduce required stocking levels for naturally regenerating stands to 50 trees per or more of any species. 3) Allow for a variable spacing and a true ICO approach by eliminating individual tree spacing requirement when thinning existing plantations. 4) Minimize the use of herbicides for controlling native vegetation as much as you can.

144

Response: The Forest Service considered many similar and opposing comments submitted during scoping on the Proposed Action to identify the Reforestation Method significant issue (EIS, p. 18). Alternatives 3, 4 and 5 address that issue by considering a variety of reforestation methods and activities. Alternative 4 specifically addresses this issue by planting "Founder Stands" which compared to the other action alternatives would plant far fewer acres, minimize use of herbicides and result in lower conifer stocking across the landscape (p. 35-36).

Alternative 5

72. **Comment**: The negative environmental impacts of Alternative 2 (No Action), Alternative 3 (no herbicide), and Alternative 4 (fewer planted acres) would be greater than the effects of either Alternative 1 or Alternative 5. Therefore, we are pleased that the USFS proposed treatment is an action alternative (Alternative 1). Alternative 5 reforests more acres, and we encourage reforesting all (as many as possible) previously forested acres destroyed by the Rim Fire. There are proven reforestation techniques, from deep ripping to use of herbicides and livestock grazing to suppress competing vegetation, that we strongly support your use of in the Rim Reforestation. The increased slope of 35% for deep tilling in Alternative 5 will also help increase the amount of reforested acres and has only a slightly elevated risk of erosion in comparison to Alternative 1 (DEIS, p. 208-209).

94 158

Response: The Forest Service considered many similar and opposing comments submitted during scoping on the Proposed Action to identify the Reforestation Method significant issue (EIS, p. 18). Alternatives 3, 4 and 5 address that issue by considering a variety of reforestation methods and activities. Alternative 5 specifically addresses this issue by planting more acres, using herbicides and deep tilling areas up to 35% slope (p. 37-38).

73. **Comment**: The application of Alternative 5 across the total reforestation landscape would pose even further risk than Alternative 1 for creating an even-aged fuel arrangement and an unnaturally risky continuity of fuels.

304

Response: While Alternative 5 would initially plant more trees per acre than Alternative 1, pre-commercial thinning at age 7 would significantly reduce tree densities long before tree crowns begin to touch (refer to response to comment 91 for more details on tree crown development). Thinning would also create the desired fire resilient structure in the Strategic Fire Management Areas or Features as well as within all plantations. Modeling predicts similar fire effects for both alternatives during the early phases (first 20 years) of their existence (EIS, p. 125). Fuels will be broken up by creating a clumpy groupy structure, having different densities of trees within SFMA features and maintaining low levels and sizes of competing vegetation within treatment units.

74. **Comment**: Alternative 5 would potentially treat natural regeneration units where currently stocking exceeds 300 trees per acre. Even if some amount of mortality does reduce stocking in those areas, instead of leaving those sites to continue to produce forest stands that are a natural outcome of regeneration naturally occurring after the fire, Alternative 5 apparently would allow for those natural regeneration sites to be cleared, sprayed, planted with seedlings, sprayed, and sprayed again – all in hopes of getting the stocking that is far higher than healthy for forest conditions. This defies logic, good use of taxpayer dollars, and any goal of sound forest management.

308

Response: While Natural Regeneration units in Alternative 5 are included in the acres listed under reforestation, removing natural regeneration from areas that are well stocked with desirable conifer species only to artificially reforest the same area was not intended under any of the alternatives. Chapter 2 states that planting will occur in areas with limited or no natural regeneration; no planting will occur in naturally regenerated areas (EIS, p. 22).

75. **Comment**: Alternative 5, which would reforest a maximum of 25,331 acres, is the best of the action alternatives. However, the alternative still leaves thousands of acres of productive forest land deforested. AFRC believes Alternative 1 is too risky because, among other concerns, prescribed fire in young plantations is unproven and may lead to unacceptable results.

194

Response: The Forest Service considered many similar and opposing comments submitted during scoping on the Proposed Action to identify the Reforestation Method significant issue (EIS, p. 18). Alternatives 3, 4 and 5 address that issue by considering a variety of reforestation methods and activities. Alternative 5 specifically addresses this issue by planting more acres and not introducing prescribed fire into new plantations (p. 37-38). While prescribed fire is proposed in new plantations under Alternatives 1 and 3, tree mortality modeling would be used prior to implementation to determine the most opportune time and place for fire reintroduction (p. 22-23).

76. **Comment**: We recommend a modified Alternative 5 rather than Alternative 1. Alternative 5 (with modifications that include portions of Alternative 1) reforests the most acres within the SFPUC watersheds. It is financially and ecologically sound to allow natural existing conifer regeneration to survive and grow. Units M012, Y009, Y019, Y022, and Y027 are the only Natural Regeneration units within the affected watersheds (see Attachment). The SFPUC understands the concept of a 5-year monitoring period before site preparation and planting and recommends including "Natural Regeneration" into Alternative 5. Include prescribed fire in established plantations after plantation trees reach conditions that will allow tolerance to flame lengths. This may be a shorter or longer time period than 10 years depending on various factors (e.g., site class, tree species, competing vegetation, etc.). The SFPUC recommends adding a desired pre and post-burn stand description to the 10 year time period. The watershed analysis indicates Alternatives 1 and 5 are similar for direct and indirect effects and cumulative effects (DEIS, p. 335-336). This supports the SFPUC recommendation to select Alternative 5 as modified.

64 91 92 93 100

Response: Tree mortality modeling would be used prior to implementation of prescribed fire in new plantations to determine the most opportune time and place for fire reintroduction (EIS, p. 22-23); therefore, the timing of reintroducing prescribed fire into new plantations may vary as described in the comment. Natural Regeneration units and prescribed fire in new plantations are included in Alternatives 1 and 3.

Alternatives Considered but Eliminated from Detailed Study

77. **Comment**: On page 49, the Low Density Planting option is dismissed as a feasible alternative suitable for detailed study. One reason (which is easily rejected) is that it would supposedly not meet the objectives for restoring old forest for wildlife. “Old Forest Habitat” is not synonymous with high numbers of conifer trees. It does relate to a moderately closed canopy that may in some instances be defined as 60% cover. But that cover can be generated by mature oaks and other hardwoods as well as conifers. So having high numbers of conifers does not necessarily equate with old forest habitat values. Having as few as 50 mature trees (some hardwoods, some conifers) per acre can easily provide the canopy cover objective. What is legally problematic is the rationale given that the Low Density Planting alternative is not acceptable for detailed study because: “The units would not meet stocking standards set by the Region.” First, that fails to acknowledge that the standards are only guidelines and not mandates.

243 271

Response: Although the Forest Service Region 5 Reforestation Handbook (FSH 2409.26b, Chapter 4) provides both recommended and minimum acceptable stocking levels, it states that a “certified silviculturist can approve alternative stocking levels based on a site-specific prescription” (p. 3). The Reforestation Handbook also explains that prescribed planting densities “should be a function of predicted survival and the target tree size expected at a specific decade” (FSH 2409.26b, Chapter 3, p. 12). The seven distinct planting densities proposed under Alternative 1 are designed to achieve a range of stand densities in the future that are similar to historic densities of mature stands (11 to 134 trees per acre), are based on site conditions that correlate with different slope positions, and are generally lower than the Region’s recommended stocking levels of about 250 trees per acre at year 20 (EIS, p. 10-12, 26-29, 246-249). The specific decade used to determine planting densities is age 60 (p. 236). At this age the majority of the trees are beginning to reach the optimal size and age to be considered sexually mature (p. 241-242), but have been impacted by several decades of biotic and abiotic forces that influence tree survival and growth. Therefore, planting densities selected to account for initial seedling mortality based on past survival exams from the Stanislaus (p. 242). Similarly, growth models were used to estimate tree growth and additional background mortality over time (p. 241). Based on these variables, as well as oak buffers, the highest planting density of 303 trees per acre is expected to decline to about 179 trees per acre and the lowest planting density of 152 trees per acre would decline to less than 100 trees per acre after 60 years (p. 261). Although these future densities are slightly greater than historic densities, they assume that no additional significant loss of conifers would occur over the next several decades (e.g., prescribed fire at year 10 would kill no trees). Alternative 1 would also allow for a wider range of multiple uses compared to lower tree densities while not posing significant forest health issues (p. 265-267). In contrast, the Low Density Planting Alternative would plant only 40 to 100 trees per acre, which would not fully reflect historic stand densities even with no oak buffers and 100% conifer survival over the next 60 years; nor would it provide as much flexibility for multiple use management. Similarly, Alternative 4, with Natural Regeneration and Founder Stands would plant only 13 acres total across the entire project area with a planting density of 80 trees per acre, which would not achieve the long-term desired stocking levels approved by the certified silviculturist.

Alternatives for the Record of Decision

78. **Comment**: On behalf of the John Muir Project of Earth Island Institute (JMP) and the Center for Biological Diversity (CBD), we are submitting these comments on the Draft EIS (DEIS) for the proposed “Rim Reforestation” (Project). Based on the foregoing, we recommend either the No Action alternative, or a greatly modified version of Alternative 4 that would implement only the noxious weed eradication component of that alternative.

326

Response: Alternative 2, the required no action alternative, is the baseline for comparing the action alternatives 1 (EIS, p. 18). Alternatives 3 and 4 would treat only those noxious weed populations that can be effectively eliminated through non-chemical means (p. 33, 35).

79. **Comment**: YSS asks the USFS to approve a final plan that divides the 21,300 acres to be reforested into four generally equal sections with each of the action alternatives to be applied appropriately to one of the four sections (of 5,000 plus acres).

Alternative 1 would go forward as promoted by the Forest's team and described in the DEIS.

Alternative 2 is already being implemented across thousands of acres that were dropped from salvage logging due to the scaled down Rim Fire salvage logging plan. This provides extensive opportunities for comparing "no reforestation" areas with the active reforestation approaches.

Alternative 3 would be slightly modified to be more effective at reforesting areas with bearclover by allowing up to two herbicide spray treatments (either one for site prep and one for release or instead two for release) in units where bearclover would generally threaten conifer seedling survival. Thus, Alternative 3 would become a "Low Herbicide" strategy, rather than a "No Herbicide" strategy. Where non-herbicide release treatments would be beneficial, hand release would be done with a maximum of two hand grubbing treatments in 5 years (whether for site prep and release or only for release). In order to respond to the broadly supported approach for a lower planting density and an initial effort to begin with a mosaic ICO pattern of conifers, the Low Herbicide alternative would plant 120-170 trees per acre across the 5,000 plus block of acres to be reforested (based on slope location, etc.). To create stocking diversity, the Low Herbicide alternative would have acres planted with one row of tree seedlings planted roughly 20 feet apart. The next row would have 25-foot spacing between 3-tree clumps with trees spaced 8 feet apart. The next row would again be single trees spaced evenly at 20 feet apart. The fourth row would be the three-tree clumps (25 feet from last clump with individual trees spaced 8 feet apart). To provide for increased openings, oaks would be buffered from planted conifer seedlings by 30 feet instead of 25 feet.

Alternative 4, the founder stand planting design, would go forward as described in the DEIS with possible minor modifications suggested by the proponent group(s) that brought forward that proposal during scoping and reforestation workshops.

Alternative 5 would go forward as described in the DEIS, with possible minor modifications suggested by the proponent group(s) that brought the proposal forward during scoping.

157	245	267	269	293	319	444
448	449	450	451	452	453	455
468						

Response: The Responsible Official will consider all specific written comments prior to making a decision to select any alternative or a combination of activities from other alternatives (1.06 Decision Framework).

Cumulative Effects

80. **Comment**: The DEIS does not adequately address the cumulative impacts of grazing, especially on grazing of riparian vegetation which the birds depend on so heavily for habitat needs. Grazing exacerbates many other impacts on birds and other wildlife from the fire and project related activities. We realize that livestock grazing is listed as an "unknown stressor" (p. 95) because the levels of livestock that will be allowed to graze within the burn area has not yet been determined. However, this is an insufficient analysis because there is already a low level of grazing occurring within the burn footprint which could be used as a basis for analysis. Alternatively a modified figure smaller than what grazing levels were before the fire-could be used. This is especially important when combined with the fact that the DEIS (p. 135) describes that when herbicide use increases, grazing pressure in areas where herbicides are not applied, like riparian areas, increases. Natural regeneration of such riparian areas would then be significantly delayed or altered by grazing. The DEIS does not propose any mitigation for this adverse impact which should be a part of the reforestation plan if an "ecologically healthy and resilient landscape rich in biodiversity" is to be created.

170 313 314

Response: The EIS discloses the cumulative effects of reforestation activities when combined with the effects of other project and ongoing activities, including livestock grazing. The EIS (Chapters 3.03, 3.07, 3.15, and 3.16) describes the cumulative impacts of project activities combined with the impacts of other projects and ongoing activities, including livestock grazing, on aquatic species, rangeland vegetation, watershed condition and wildlife. The analysis of cumulative effects is proportionate to the expected degree of impacts. Appendix B (EIS, p. 516) provides information about livestock grazing, and discloses the maximum number of cattle run across all grazing allotments intersecting the project area (about 1,632 cow/calf pairs in any given season). Livestock grazing is subject to Forest Plan standards and guidelines that protect resources such as riparian vegetation. Natural regeneration of riparian areas is occurring in the project area, and is not expected to be measurably delayed or altered by grazing. While the potential for cumulative effects exists, implementation of Forest Plan standards and guidelines would mitigate potential impacts to sensitive resources associated with livestock grazing.

Purpose and Need

81. **Comment**: The DEIS (p. 7-11), attempts to narrowly define Purpose and Need. In doing so, judgments are provided that can easily be debated. For instance, the claim is made that only by planting "clumped" trees 1 to 2 feet apart can enough trees be initially planted in the proposed Old Forest Mosaic to create the desired 60-80 % canopy objective. There are many rebuttal responses that can dispute that as a legitimate excuse to rejecting "planting in various clump and spacing configurations." The agency uses the Purpose and Need statement to attempt to justify action alternatives that will move the burned landscape in a direction that more or less achieves the Purpose and Need objectives as narrowly defined by Forest staff. Those key Forest staff perceive a "mixed conifer landscape" to be one that is stocked at a moderate to high density with commercially valuable conifer trees capable of producing a commercial thin at 20 years of age and productive timber sales in years beyond that stage.

265

Response: The Purpose and Need is based on the relationship between the desired conditions and the existing conditions (EIS, p. 7-10). As stated in FSH 1909.15 Section 11.21 "A well-defined "need" or "purpose and need" statement narrows the range of alternatives that may need to be considered" (FSH 1909.15, 11.21). The Forest Service considered many comments submitted during scoping on the Proposed Action to identify significant issues (EIS, p. 18). Three additional action alternatives address these issues by considering a variety of reforestation methods and activities (p. 32-38). The four action alternatives include 15 different planting patterns that vary in density ranging from 100 to 514 trees per acre and include varying clump and group sizes and patterns. In some instances far fewer trees per acre are proposed because founder stands and deer cover stands only reforest 20 to 25% of the area proposed for reforestation.

The intent of describing "clumped" trees 1 to 2 feet apart was to communicate the difficulty in balancing the desire to create clumps of trees as opposed to evenly spaced trees, but still achieve higher tree densities to ensure desired future stocking and canopy cover. For example, historic estimates of natural conifer regeneration ranged from 350 to 4,000 seedlings and saplings per acre (p. 247). To create a clumpy distribution of seedlings with densities of 350 to 450 trees per acre as historically might have occurred, seedlings would need to be spaced about 1 to 2 feet apart within clumps. As noted in the EIS (p. 11), however, this would create a situation that the

Forest Service wanted to avoid, the need to thin dense patches of saplings that historically would have been thinned by fire, competition and other modes of mortality in the long-term.

None of the action alternatives would result in the need to perform a commercial thin by year 20. Out of all the action alternatives the earliest that the densest plantations would need to be thinned is between 40 and 50 years after establishment based on inter-tree competition and bark beetle induced SDI thresholds (p. 265-266, 281, 284-285, 287). Many of the planting densities would be low enough to not require thinning even after 60 years.

82. **Comment**: Without defining our end destination, it simply is not feasible to determine the needed course of action. We strongly encourage the forest service to provide a clearer description of the future desired condition that this reforestation plan aims to achieve. We offer one vision for future desired conditions, which comes from the California Forestry Foundation website: "Restoration forestry is a vision for the future rooted in respect for the past. Thus, restoration forestry uses the historic forest as a model for the future forest. No scientist, forester, or environmental activist could conceive of more beautiful or diverse and sustainable forests, with more wildlife, than those found by the first European explorers… The goal of restoration forestry is to restore and sustain, to the extent practical, a forest to a condition that resembles, but does not attempt to duplicate, the structure and function of a reference historic forest. The term "reference historic forest" means the way a whole forest appeared spreading over a landscape, with all of its diversity, at or about the time it was first seen by European explorers." While there are not detailed scientific studies that far back, we do have the benefit of the 294 transects done in 1911 within the area later encompassed by the Rim Fire. Combining that with other data from that or earlier period would allow creation of a future condition greater with greater specificity of what we seek to replicate.

463

Response: The EIS (p. 7-10) defines the desired future condition as part of the Purpose and Need which guided development of the action alternatives. The Forest Service considered historic reference conditions, climate change, fire frequency and severity on this landscape and future wildlife habitat needs when identifying the desired future conditions and when evaluating how well the different alternatives might achieve those conditions (p. 8-11, 235-236, 246-248).

REFORESTATION

83. **Comment**: The DEIS envisions that monitoring the effectiveness of the reforestation effort will occur, however an explicit, statistically sound monitoring plan must be developed to guide the effort to experiment with planned treatments. The monitoring plan must have an estimated budget, timelines, and responsible officials. Using the principles of adaptive management, if the monitoring shows that the expected results (survival and growth) are not being attained, there must be a plan to adjust the reforestation treatments to meet project objectives. Monitoring must also include documentation and analysis of the costs of each of the selected methods for use in future budget requests.

200

Response: The EIS (p. 231-233) outlines laws, regulations and other direction applicable to reforestation projects. Specifically, the National Forest Management Act of 1976 requires that "All national forest lands treated from year to year shall be examined after the first and third growing seasons and certified … as to stocking rate, growth rate…Any lands not certified as satisfactory shall be returned to the backlog and scheduled for prompt treatment." The Forest Plan Direction also includes evaluation, certification, and monitoring as management practices necessary to reestablish desirable tree species by artificial methods on deforested areas (USDA 2010a, p. 17-32). To ensure compliance with the NFMA, the Forest Service Handbook and Manual outline specific protocols for conducting survival and growth exams (FSH 2409.26b, Chapter 4; FSM 2470). These protocols would also be used to monitor the effectiveness of treatments and the need to adjust treatments (e.g., apply herbicides or forego application of herbicides).

84. Comment: All of the alternatives carry some risk of not meeting the objectives in the best possible manner. Therefore, we support using the reforestation project to implement and evaluate all of the listed alternative approaches, including the wildlife protections in each, to determine the best way to manage reforestation going forward. Areas within the project footprint that are selected for each approach should be based on where the particular alternative would be most likely to succeed. We recommend that the study be designed and evaluated to withstand scientific and public scrutiny, perhaps by regional ecologists and other scientists from the PSW Experimental Station. We believe that this approach will give the forest managers the best science based information going forward, and will enhance diversity and sustain a natural forest, a forest that encourages beneficial fire instead of a forest that can't tolerate fire. We believe that the scientific monitoring and research component of this strategy is critical and suggests that that the Forest Service researchers conduct public workshops to educate and gather input to develop the best plan from which the best conclusions can be drawn to withstand scientific and public scrutiny.

174 175 438 454

Response: While none of the alternatives specifically incorporate scientific research activities, this would not negate the possibility of those who desire (e.g., Pacific Southwest Research Station or Universities) to use the Rim Reforestation project for the basis of scientific study.

85. Comment: There is strong documentation that fewer trees per acre will add more wood mass per acre generally than denser stocking levels. Additionally, these fewer but larger trees will sequester significantly more carbon than a greater number of smaller trees.

465

Response: Carbon makes up about 50% of live wood mass (Thomas and Martin 2012), so the influence of tree size and stocking density on live wood mass is very similar to effects on live tree carbon storage. For most temperate tree species, mass growth rate increases continuously with tree size; therefore, individual large trees actively fix large amounts of carbon compared to individual small trees (Stephenson et al. 2014). However, even though individual small trees sequester less carbon than individual large trees, higher densities of smaller trees can sequester and store more wood mass and carbon per acre than fewer large trees per acre (Hurteau et al. 2011).

Planting Density and Pattern

86. Comment: The amount of site preparation for planting is significant due to the dramatic resurgence of brush following the Rim Fire just 3 years ago. The importance of site preparation, tilling, planting, and release with herbicides cannot be overstated and is the least cost method in the long run. Getting the proposed 26,009 acres (including natural regeneration and deer habitat enhancement) back into a productive forest as soon as possible is crucial to avoid substantial type conversion to brush fields. Because of the experienced rapid resurgence of brush, the denser spacing of planting provides the best opportunity of returning the most acres to productive forest land in the long run.

15 28 159

Response: Alternatives 1 and 5 would result in the most forested acres, yield the most timber volume by age 60 and increase the number of large trees on the landscape faster than the other alternatives (EIS, p. 288-290). In contrast, Alternative 3 includes similar site preparation, deep tilling, and planting, but does not include the use of herbicides to control competing vegetation. A similar number of acres would be reforested under Alternative 3, but it would have lower canopy densities, yield less timber volume and produce fewer large trees across the landscape by year 60 (EIS, p. 288-290).

Of the action alternatives: Alternatives 1 and 5 would have the highest economic efficiency, and with the exception of Alternative 3, create the most jobs; and, Alternative 3 could potentially create more jobs because intensive manual release treatments would require a large work force (EIS, p. 190-191). While Alternative 3 may provide the greatest potential for creating jobs, it should be noted that past manual release efforts on the Stanislaus were ineffective because many contracts went into default and volunteer groups only completed small areas, resulting in much work never completed (p. 281). Additionally, manual releases were ineffective in areas with abundant bearclover and other sprouting species (p. 279).

87. **Comment**: The proposed planting densities of 150 trees per acre or more is too high for the following reasons. Mature forests historically had much lower tree densities; it is not how the forest would develop naturally and is more like a tree farm; it will result in even-aged plantations; it creates dense, homogeneous conditions; and, there is no meaningful ecological rationale to immediately force such a large proportion of the landscape into an overly-stocked condition.

2	3	7	129	140	151	153
155	179	239	266	273	435	436
437	465					

Response: The EIS (p. 246-248) provides details on historic forest structure. One study from the Stanislaus showed historic tree densities in mature forests ranged from 11 to 32 trees per acre (Collins et al. 2015). While mature tree densities were relatively low, seedling and sapling densities within these same plots ranged from 369 to 637 trees per acre (personal communication, Brandon Collins). Another study in the Sierra Nevada showed that mixed-conifer forests with intact fire regimes have mature tree densities that range from 45 to 134 trees per acre with 486 to 4,087 seedlings and saplings per acre (Lydersen and North 2012). Over time various modes of mortality, especially frequent surface fires, would reduce the number of seedlings and saplings that would survive to maturity (p. 247-248). The majority of the various planting densities proposed under the different action alternatives fall well short of what naturally occurred historically (p. 26-38). The number of conifers per acre planted is based on a wealth of local experience and research that provides a well-informed baseline for predicting seedling survival and growth when associated reforestation activities (e.g., site preparation and release treatments). Although fewer seedlings are planted, a greater proportion are expected to survive. After 60 years or more, when trees begin to reach maturity, stand densities are expected to begin to reflect historic densities (p. 261-262, 279, 283, 286). Planting 150 conifers per acre would result in at most about 100 trees per acre after 10 years across the entire project area. As trees begin to reach maturity after 50 to 60 years, few if any areas within the project area would exceed 100 trees per acre, let alone reach historic densities of 134 trees per acres. In addition, removal of trees for timber production would not be possible in order to retain these minimum tree numbers across the landscape for old forest structure.

The Rim Fire created conditions not considered characteristic of natural or similar to historic post-fire conditions (p. 10, 251-252). Therefore, regenerative processes or forest succession are not expected to follow a natural trajectory (refer to response to comment 21 for further discussion on natural forest development). As a result, an even-aged structure is expected to develop even if no action is taken. Preliminary conclusions from Malone et al. (2015) suggest that unassisted development of uneven-aged structures may require hundreds of years to develop following large, high-severity wildfire. Additionally, Crotteau et al. (2013) found that shade-intolerant pine species comprised only a small proportion of the conifer regeneration occurring in high-severity areas following another uncharacteristically large wildfire. Crotteau et al. (2013) arrive at the following conclusion: “The lack of sufficient Pinus spp. densities after High-severity fire in the Mixed Conifer and Low-elevation Fir forest types is alarming as the reduction in pine may result in an ecosystem type shift” (p. 109). Plot data collected by the

Stanislaus suggest a similar trend in species composition is occurring in the Rim Reforestation project area (Table 3.13-8).

88. **Comment**: It is important to recognize that our climate trend is shifting to longer, hotter, drier conditions across the elevations considered for action by this reforestation plan. Under drought situations, when 10 or 15-year old plantation trees suffer from a lack of water, the increased stocking of 200 or more trees per acre will exacerbate the competition between trees for precious water for survival, rather than a situation where having 40 to 100 trees per acre that are more widely spaced or clumped would result in less water competition. A final point in this matter is that a review of literature related to conifer mortality and irruptive bark beetle outbreaks describes that there is some level of benefit when forest stands are thinned or spaced with trees separated individually instead of being partially shaded by adjacent trees and competing for limited moisture and nutrients under drought conditions. Having less dense tree stocking increases water and nutrients available to individual trees and is considered one of the most effective “indirect control” treatments that can be applied in order to proactively reduce the vulnerability of forest stands to bark beetle attacks (in particular, mountain pine beetle). With beetle outbreak conditions being so extreme, this further justifies a planting density and stocking standard that is far lower.

272 307

Response: The EIS (p. 234) uses SDI as an indicator for evaluating vulnerability to drought, insects and inter-tree competition. As noted in the discussion for this indicator, SDI levels below 285 to 315 (55 to 60% of the maximum SDI) provide for reduced density-related mortality and relatively high tree vigor (Oliver 1995; Long and Shaw 2012). Additionally, Oliver (1995) and Oliver and Uzoh (1997) determined that ponderosa pine stands start to show increased bark beetle-related mortality at SDI 230 (about 45% of maximum SDI). As stands approach SDI 365 they are more likely to suffer large losses from bark beetle epidemics (Oliver 1995). None of the plantations under Alternatives 1 or 5 would reach SDI 365 within the next 60 years (p. 265-266, 287); therefore, the worst case scenario for all the plantations would be low levels of mortality from endemic bark beetle populations (Oliver 1995). As noted in the EIS (p. 265-266), the densest planting patterns under Alternative 1 (i.e., drainages and mid-slopes) would require between 40 and 50 years before SDI levels reach 230. Therefore, the densest plantations under Alternative 1 would require between 40 and 50 years or longer before bark beetles, drought or inter-tree competition pose potential management issues. When taking into account the potential tree mortality from introducing prescribed fire around age 10, SDI levels would likely require even more time before density causes declines in tree vigor. Similarly, thinning in young plantations, if needed, under Alternative 5 would reduce conifer densities at age 7; therefore, plantations would require between 40 and 50 years before they reach or exceed SDI 230 (p. 287).

89. **Comment**: Future commercial timber yield must happen as it happens. The DEIS states, …management feasibility would improve if increasing fuel loads and stand densities are balanced with larger trees that can at least partially offset operational costs when thinned. Is it reasonable to assume that the US Forest Service will enter these reforested areas after several decades to do the actual thinning? Much of the area burned by the Rim Fire consisted of 15 to 40 year old plantations that were not thinned. A plan to remove shrubs and stock high densities of trees so that they can later be logged for timber sales is not consistent with past practices, ensuring that “vegetation and fire management efforts are grounded in concern for biodiversity and ecological process…,” nor creating a “fire resilient mixed-conifer forest that contributes to an ecologically healthy and resilient landscape rich in biodiversity.”

124 212 433 439

Response: Of the 154,530 NFS acres burned by the Rim Fire, less than 20,000 acres were known plantations. Only 22% of these plantations experienced high severity fire (EIS, p. 255) and are proposed for reforestation in this project, while 78% were in the low and mixed severity categories. Furthermore, it is reasonable to assume that the Forest Service will thin plantations in the future. As noted in the EIS (p. 256), many of the Granite plantations were thinned prior to the Rim Fire. Additionally, portions of the younger plantations established after the 1987 Stanislaus Complex Fire and 1996 Rogge Fire were pre-commercial thinned or were in the early planning stages for developing thinning prescriptions when the Rim Fire started. In the past, however, management objectives focused on thinning plantations to a relatively uniform spacing and leaving more trees per acre to increase future timber yield, which is why many of these same plantations need to be thinned again today. Unlike past reforestation practices, planting patterns and densities proposed in this project are tailored to reflect ecological processes (e.g., different patterns and densities based on slope position) and would not require thinning for at least 40 to 50 years (p. 267-268, 281-282, 284-285). Even in the absence of conifers, vegetative biomass will accumulate over the next few decades and the combination of mechanical fuels treatments and prescribed fire will be necessary to maintain fire resiliency (p. 234-235). Proposed planting densities for all alternatives are low enough to avoid developing overly stocked stands during the next 40 to 50 years, but could still provide some merchantable sized trees when management is deemed necessary (p. 265-266, 281, 284-285, 287, 289-290).

90. **Comment**: High planting densities will negatively affect wildlife, recreation and visual resources. The density of trees will literally blanket the landscape so thickly that deer and people will not easily be able to move through the 30 square miles of plantations at 10-15 years of age. Wildlife depends on a habitat consisting of many different types of plants and a healthy forest needs more than one type of tree.

129 307

Response: Chapter 2.02 shows the action alternatives consider a wide variety of planting densities and compositions including areas specifically identified as deer units within critical winter range. These units have unique planting and thinning prescriptions designed to promote and enhance the habitat for deer. Planting units are scattered throughout the 257,000 acre Rim Fire area and plantations would not be in one large contiguous block. All the reforestation prescriptions include planting ponderosa pine, sugar pine, incense cedar, Douglas-fir, white fir and giant sequoia based on seed zone, site and elevation to meet the desired future condition (EIS, p. 22). Under Alternatives 1, 3 and 4, prescribed fire is proposed within new plantations at age 10 which would reduce fuels and brush, kill some trees and further contribute to heterogeneity at the stand and landscape scales. The amount of trees proposed for planting are not expected to reach stand-level closed canopy or interlocking branch conditions until at least age 50 and would not inhibit deer or people movement through the forest (refer to response to comment 91 for more details on tree crown development). On the other hand, these low density planting numbers will result in increased brush cover which could impede movement in some areas. Prescribed burning in existing plantations, reforestation areas and chaparral dominated areas within the critical winter range area near Jawbone Lava Cap (p. 454-455) will provide many benefits for mule deer including maintaining a variety of plants throughout the area.

The impact to recreational users from high tree densities is expected to be non-existent. None of the alternatives propose planting high densities of trees similar to numbers planted after the 1987 fires. All action alternatives propose to plant a variety of species in a variety of patterns (except for Alternative 5 that would thin to those patterns at age 7 if necessary and well before trees begin to develop interlocking limbs). Figure 3.13-5 shows a 15 year old plantation with trees about 14 feet apart. The branches are only about 3-4 feet long and shrubs are still growing up through them. High shrub cover that will develop after release treatments stop is expected to impede cross country travel far more than planted trees.

The EIS (p. 296) shows the various planting designs would move the landscape towards meeting the long-term VQOs and are appropriate under the interim rehabilitation VQO. In the short-term, 10 to 15 years, the horizontal diversity of the different planting patterns would appear relatively natural as opposed to uniform rows of individual trees. Vertical structure would remain fairly homogenous during the first few decades because the trees are the same age; however, this would likely be the case where natural regeneration is occurring because there are few if any live trees remaining in severely burned areas. As the plantations mature and natural processes including natural regeneration and mortality occur, the plantations would appear more complex both horizontally and vertically.

91. **Comment**: At stocking levels of 200 to 300 trees per acre, if 25% mortality occurs, those tree plantation areas will be stocked at 150 to 225 trees per acre at 10 years of age. If growth is vigorous, each tree will be nearly touching or directly touching adjacent trees. If a wildfire burns into these plantation locations when the young trees are 5 to 20 years of age, the close fuel arrangement and fuel continuity will create extremely high probability of torching, crown fire flame spread, and significant mortality of the planted conifers. Highly flammable at-risk conditions will be created if the Forest Service plants conifer plantations with stocking of trees as close as 14-15 feet (or closer) in rows or in so-called "macro-clusters" (which are simply 25 to 100 trees planted evenly spaced in either 5 or 10 rows with a row then skipped to create some appearance of "diversity"). Planting in a fine scale mosaic pattern of individual trees, clumps, and openings has many advantages, including fire resiliency.

7	151	152	153	278	280	281
282	307	436				

Response: Alternative 1 would result in a variety of planting patterns and densities that correlate to different slope positions (Table 2.02-2; Figure 2.02-3). The EIS (p. 10-11) shows research conducted on the Stanislaus found that historic forest structure consisted of individual trees and small openings distributed among various sizes of tree clumps ranging from small (2 to 4 trees) to large (10 to 33 trees) with in-clump tree spacing averaging between 10 and 12 feet (Lydersen et al. 2013). The EIS (p. 261-262) cites other research that found ridges and upper slopes typically had the lowest tree densities consisting of small clumps and individual trees, while lower slopes and drainages typically had higher tree densities consisting of larger clumps of trees (Lydersen and North 2012). Alternative 1 proposes seven distinct planting patterns and densities (p. 26). Depending on the slope position and whether or not an area is within a Strategic Fire Management Area (SFMA), initial tree spacing under Alternative 1 would range between 10 and 27 feet; this is assuming there are no obstructions to planting (p. 26). Oak buffers, initial seedling mortality and other factors that limit planting (e.g., sensitive plant exclusions, rock outcroppings and cultural sites) would break up the uniformity of planted conifers and result in lower conifer densities with less spatial uniformity and less opportunity for interlocking limbs. Accounting for only oak buffers and initial seedling mortality, conifer densities would range between 104 and 207 trees per acre after 10 years (Table 3.13-9). Assuming no conifers are killed when prescribed fire is introduced after 10 years, conifer density would fall to between 98 and 179 trees per acre after 60 years due to natural levels of background mortality (p. 261). Growth modeling estimated that on average most trees would require 20 to 30 years to develop crown widths of about 10 feet in diameter (i.e., 5-foot limbs). Therefore, interlocking crowns would only occur between trees within clumps after the first 20 to 30 years or more. After 60 years, the average crown diameter would be about 17 feet with the largest trees having a crown width of about 24 feet. Therefore, even the largest trees after 60 years would have a crown radius of about 12 feet. As noted in the comment some planting patterns would skip rows of trees to promote creation of larger tree clumps. These larger clumps would be similar in size to the larger clumps described by Lydersen et al. (2013). For example, skipping a row of trees after every fifth row in both directions, such as the mid-slope OCM pattern within SFMAs, would initially create clumps of 25 trees with about 24 feet between clumps. At this distance between clumps, only the limbs of the largest trees at age 60 would begin to touch, but trees of average size would not. However, the initial uniformity of 25-tree clumps occurring in orderly rows would diminish as about 25% of the seedlings die in the first few years and as oak buffers and other limitations to planting are incorporated into the spatial pattern. As a result, a variety of individual trees, tree clump sizes and varying widths between clumps would emerge within this one planting pattern. At a slightly broader scale, a variety of tree spacing and clump sizes would be accentuated by the seven different planting patterns stratified across the different slope positions, which would further reduce the possibility of large blocks of forest with continuous tree canopy.

92. **Comment**: The planting strategy in Alternative 1 will actually make it impossible for managers to prescribe burn effectively. When trees are heavily stocked at 200-300 trees per acre, those sites will be too densely stocked at the surface fuel level until at least 15 years of age or later (when lower branches have been shaded out to some degree). Only if some amount of pre-commercial or commercial thinning takes place will the uniform bed of flammable fuel be broken to the degree that prescribed burns could be done feasibly. Yet the fire history within the Rim Fire reforestation area proves that high severity wildfires ignite and burn rapidly across the Tuolumne River watershed in areas proposed for conifer plantations. Fires have burned every 10-15 years or so in the recent past, and given the magnitude and intensity of other fires, it is unrealistic to expect that wildfire will not threaten most of the reforestation units prior to a commercial thin at 20 years of age. Unless frequent low-intensity prescribed fire is applied to reforestation units while the trees and brush are relatively young, the potential will be high for a wildfire to move through the reforestation acres and decimate the planted conifers. Thus, a lower stocking level combined with a far more widely dispersed pattern of conifer planting has greater likelihood of surviving a wildfire in the first two decades.

46 149 283

Response: Fire modeling based on tree density, species composition and other characteristics of fuel loading determined that in the short-term (20 years) fire related mortality between alternatives would be negligible (EIS, p. 125). Flame lengths in Alternative 1 are estimated to be less than or equal to four feet during the first 20 years post treatment (p. 117). Growth modeling estimated that most trees would require 20 to 30 years to develop limbs 5 feet in length (refer to response to comment 91). Under Alternative 1 within planted tree clumps, the majority of trees would be spaced 12 to 15 feet apart, but distances between clumps would extend as far as 24 to 27 feet apart (p. 26). While flame lengths of four feet may result in isolated torching within clumps, there is a lower probability that sustained crown fire could occur between clumps during the first 20 years. In the event that conditions do result in crown fire within the more densely stocked drainages and mid-slopes, incorporation of sparsely stocked ridges, fuelbreaks and emergency travel routes would aid in fire suppression effectiveness and increase the likelihood of tree survival in young plantations (p. 125). Additionally, prescribed fire is proposed in young plantations at age 10 which would likely reduce conifer density to some extent and maintain lower surface fuel loading.

93. **Comment**: The ICO planting patterns appear complicated, may be difficult to achieve during field operations, and may result in too few surviving conifers to meet the stated goals. An example of the anticipated difficulty of attaining adequate reforestation with alternative planting prescriptions in the DEIS (p. 28), where 25% mortality is expected in areas treated with DTFC and herbicides. Approximately 50% mortality is expected in areas that have only mechanical and/or hand treatments. Given the estimated cost of up to $1,300/acre for reforestation, it is hard to believe that an alternative that expects 50% mortality could be considered responsible management. California has had years of reforesting coniferous forests following large fires. The results of these efforts have been documented in silvicultural studies, some of which are cited in published studies in Chapter 3.13 (particularly p. 238-239). We recommend planting more uniformly and creating the ICO pattern during thinning.

30 33 68 80 82 197

Response: The Forest Service considered many similar and opposing comments submitted during scoping on the Proposed Action to identify the Reforestation Method significant issue (EIS, p. 18). Alternatives 3, 4 and 5 address that issue by considering a variety of reforestation methods. Alternative 5 specifically addresses this issue by planting more uniformly (7 by 14 foot spacing) and providing an opportunity for thinning young plantations at age 7 to create the desired ICO pattern (p. 37-38).

SENSITIVE PLANTS

94. Comment: The EIS must consider several affected and sensitive plant species that are found within montane and mixed chaparral habitats of the Rim Fire perimeter. Deerbrush (*Ceanothus integerrimus*), Nissenan manzanita (*Arctotaphylos nissenana*), bearclover (*Chamaebatia foliolosa*), Sierra gooseberry (*Ribes roezlii*), Small's southern clarkia (*Clarkia australis*), Mariposa clarkia (*Clarkia biloba ssp. australis*), slender-stemmed monkeyflower (*Mimulus filicaulis*), and goldencarpet buckwheat (*Eriogonum luteolum*) are all found within Sierra Nevada chaparral. *C. biloba ssp. australis*, *C. australis*, and *M. filicaulis* are sensitive species, whereas suitable habitat within the Project area exists for *M. nissenana and E. luteolum*.

231

Response: Sensitive Plants are defined in the Forest Service Manual as plant species for which population viability is a concern, and it is the direction of the Forest Service to avoid actions which may cause a species to become threatened or endangered, and maintain viable populations of all native plant species in habitats distributed throughout their geographic range on National Forest System lands.

Within the Rim Reforestation project, the majority of the treatment units (98%) have been surveyed for all sensitive species based on the unit's habitat attributes and the current Sensitive Plant List (USDA 2013b). The remaining 2% will be surveyed prior to implementation. The following Sensitive Plant species listed in the comment above are known to occur within the project area: *Clarkia australis*, *Clarkia biloba ssp. australis*, and *Mimulus filicaulis* and will be protected during implementation. *Arctostaphylos nissenana* and *Eriogonum luteolum* var. *saltuarium* have suitable habitat within the project area, but were not found within treatment units (EIS, p. 159). All sensitive plant populations will be flagged and avoided by all treatment activities per Management Requirements (p. 42).

Deerbrush, bearclover and Sierra gooseberry are not Threatened, Endangered or Sensitive plant species. They are common, native shrubs that occur abundantly across the landscape and within conifer plantations throughout the Stanislaus. Because of their sheer abundance, even if some of these individual shrubs are killed or harmed in reforestation activities, their overall populations will not be negatively impacted.

SOILS

95. Comment: Tilling on slopes less than 35% will have dramatic positive effects for retaining soil moisture on site and moisture penetration. Sierra Pacific Industries has demonstrated in the past decade the value of tilling on slopes less than 35% slope. Essentially not one drop of moisture escapes the site where tilling has been employed thereby maximizing water availability to seedlings and eliminating erosion off-site.

15 29

Response: The effects to soil structure, infiltration and risk of erosion from deep tilling and forest cultivation were analyzed for slopes less than 30% (EIS, p. 202-203) and for slopes less than 35% (p. 207, 210-211). Deep till and forest cultivation treatments are expected to increase macroporosity in the short-term, especially on soils with high clay content. This may create a short-term increase in infiltration, but in the long-term, infiltration and macroporisty may be reduced as a result of the destruction of soil structure and reduction in root channels (p. 201-

203). DTFC treatments also reduce ground cover and loosen soil structure, increasing erosion risk. During light rains, infiltration may be sufficient to prevent erosion, but during high-intensity rainfall, infiltration rates can be exceeded leading to surface runoff and an increased risk of rill erosion. Consequently, the benefit of increased infiltration can often be outweighed by the large reduction in ground cover and soil fracturing which can lead to erosion.

96. Comment: A vegetative buffer strip is required on slopes over 20% during contour subsoiling (DEIS, p. 31). It is unclear why this requirement is needed since it excludes more areas from reforestation. Also, no significant erosion has occurred in nearby privately owned subsoiled lands. We recommend this requirement to mitigate potential erosion on a site-specific basis rather than for all areas over 20% slope.

87

Response: Monitoring data from the 1990s and the winter of 2015-2016 show that significant erosion can occur, especially on steeper slopes with high clay content (EIS, p. 200-201, 203, 207-208). Buffer strips were recommended based on monitoring reports written after widespread tilling done in the 1990s, and are designed to reduce the impact or likelihood of rill erosion. See the soil resource report for more information, including monitoring reports and photo documentation (project record).

97. Comment: Deep tilling is silviculture. It has no place in the management of ecologically healthy forests with rich biodiversity. Foresters have known for years that soil disturbance and the resulting reductions in mycorrhizal formations can negatively impact outplanted seedlings of conifers (Amaranthus 1990). Although some progress has been made in understanding the role of soil microorganisms and the impact of soil disturbance in grasslands, very little is known about the mycorrhizal ecosystem within native forest communities other than the fact that they play a critical role in forest health.

216

Response: As noted by Amaranthus (1990), "[w]hy mycorrhizal formation is reduced following disturbance in some areas and not others is not understood" (p. 207). As this statement suggests, the effects of different management activities on mycorrhizal formations are affected by variability in physical and biotic factors; therefore, activities such as deep tilling may or may not cause a reduction in mycorrhizal formations. Even if mychorizzal formation is reduced, planted conifer survival and growth may not be reduced. While mycorrhizae may provide some beneficial effects to conifer seedlings, these benefits have limited value because shrubs effectively compete for soil moisture; therefore, control of competing vegetation is critical for conifer seedling survival and growth because water availability is the single most limiting factor (refer to response to comment 39 for more details).

VEGETATION

98. Comment: Support the planting of a diverse forest to include blue oaks, black oaks, and gray pines. A diverse forest is more resilient to forest fires and is more visually appealing.

49

Response: Planting blue oak is included as a management requirement to supplement natural regeneration as needed in units R041, S004, T021 and T024, where blue oak naturally occurs (EIS, p. 43). Planting California black oak is not proposed because wildfire stimulates sprouting and post-fire surveys determined that oak is well distributed throughout the project area (p. 257; refer to response to comment 43). Additionally, research suggests that regeneration of California black oak is more likely to be successful from stump sprouts than from artificial regeneration (Tappeiner and McDonald 1979). Gray pine primarily occurs between 1,000 and 3,000 feet in elevation (Powers 1990). The vast majority of the Rim Reforestation project occurs at elevations above 3,000 feet. While gray pine does occur in and adjacent to some project areas (e.g., Jawbone Lava Flat), it is primarily relegated to very shallow dry soils where other conifer species cannot compete or survive. Unlike most pine species that are well adapted to surviving frequent surface fire, gray pine is well adapted to re-colonizing areas following high intensity wildfire (Schwilk and Keeley 2006).

99. **Comment**: The DEIS assumes that "the land will mostly return to continuous woody brushfields that impede wildlife movement" and iconic shrub species such as manzanitas and Ceanothus "remove the possible establishment of diverse forest habitat." Statements such as these ignore most of what ecologists understand about healthy, biodiverse forest ecosystems and natural succession. The specter of a smothering wave of shrubbery covering the landscape is contrary to established science (Shatford et al. 2007; Zald et al. 2008). While there are some areas that will indeed favor shrubs over conifers, especially in high-severity burn patches without nearby conifer seed sources, demonizing native shrubland habitat is a testament to the schizophrenia the DEIS suffers between silviculture and ecological goals. The terms "brush" and "brushfields," used 55 times in the DEIS, are employed to demonize shrubland habitats. The use of such pejorative language makes it impossible for the US Forest Service to address environmental and ecological questions in an objective, factual, and scientific manner.

204 215 223 224 233

Response: The use of terms such as "brush" or "brushfield" in the EIS are not meant to demonize shrubs or shrubland habitat. The Forest Service agrees that shrubs and shrubland habitat contribute to a diverse forest ecosystem. The terms "brush", "brushy" and "brushfield" are commonly used in scientific literature to refer to shrubs and are used in at least 40 publications cited in the EIS (e.g., Brown et al. 2004; Reinhardt et al. 2008; Shatford et al. 2007; Thorne et al. 2008; Zeglan et al. 2010; Zhang et al. 2006, 2013; Zielinski et al. 2004). The use of the term "brush" when referring to shrubs can be found in an array of peer reviewed publications including the Canadian Journal of Forest Research, Conservation Biology, Ecology, Forest Ecology and Management, Forest Pathology, Forest Science, Journal of Forestry, Journal of the Torrey Botanical Society, Journal of Wildlife Management, International Journal of Wildland Fire and Madroño. While shrubs and shrubland habitat contribute to the diversity of species and structure in mixed-conifer forests, it has been well documented that high shrub cover following high-severity fire slows the establishment and growth of conifer seedlings; thus, unassisted succession from shrub dominated vegetation to conifer forest may require a period of 100 years or more without disturbance (EIS, p. 241-242).

100. **Comment**: The DEIS asserts that, based on CALVEG cover type classifications, shrubs account for 14.71% of the land within the Stanislaus National Forest. On the other hand, by comparing estimates from Show and Kotok (1924) and USFS vegetation maps from the mid-2000's, the amount of land occupied by shrublands, such as montane and mixed chaparral, has been reduced significantly within the Stanislaus National Forest. Based on these estimates, chaparral recently covered 9.9% of the Forest as opposed to 16.2% in 1924. The US Forest Service can begin the process of valuing shrubland habitats by reconciling these numbers.

234

Response: Safford (2013) reported that "[p]ercentages of National Forest area in brushfields in the early 1920s ranged from 7% on the Eldorado National Forest, to over 16% on the Stanislaus National Forest; the overall average was about 11%" (p. 73). Safford (2013) also reported that the proportion of the productive forestland on the Stanislaus dominated by shrubs was 9.9% in the early 2000s. While the 9.9% is slightly less than the historic proportion, it was still within the historic range of similar National Forests. Safford (2013) estimated the modern values from data using mixed chaparral and montane chaparral CWHR vegetation types "where they occur in sites identified as having sufficient productivity to support forest" (p. 73). The reference to "sufficient productivity to support forest" is important here because the 14.71% (22,724 acres out of 154,530 acres; refer to Table 3.13-5) referred to in the comment is the proportion of NFS lands within the Rim Fire perimeter that were classified by CALVEG as a shrub cover type prior to the fire and are not necessarily considered productive forestland. The analysis in the EIS (p. 235) distinguishes between CALVEG cover types and CWHR vegetation types: "This analysis used the CALVEG vegetation cover type to identify a general distinction between broad vegetation types: conifer (including mixed hardwood and conifer), hardwood, shrub, grass, barren and other life form classifications. The primary focus of this analysis is the conifer and mixed hardwood-conifer cover types. Within these two conifer-dominated cover types, CWHR vegetation type, size class and density were used to describe forest structure."

The EIS assumes that "Region 5 CALVEG cover types conifer (CON) and mixed hardwood-conifer (MIX) represent suitable and productive forestland" (p. 233). Therefore, the CALVEG shrub cover type was assumed to not have sufficient productivity to support conifer forest, and was not included in the estimates of shrub-dominated vegetation occurring within the 102,618 acres of suitable and productive forestland reported in the Table 3.13-5 (i.e., conifer and mixed hardwood-conifer CALVEG cover types). As noted in the EIS, within each CALVEG cover type "some portions of non-conifer CWHR vegetation types may exist" (p. 249). Figure 3.13-2 in the EIS shows the successional classes of the productive forestland within the Rim Fire perimeter post-fire. As a result of high-severity fire, a large proportion of the productive forestland was converted from mid- and late-seral structures to early seral. These post-fire early seral acres are largely made up of CWHR vegetation types "mixed chaparral" and "montane chaparral," which now account for 39.9% (i.e., 36,870 acres out of 102,618 acres) of the productive forestland on the Stanislaus within the Rim Fire perimeter (p. 252). Under Alternatives 1, 3 and 5 a total of 26,009 acres could potentially be reforested, of which, 17,375 acres are currently classified as chaparral vegetation types (p. 255). Assuming 100% of these chaparral acres are successfully converted to conifer forest with no patches of chaparral remaining, a total of 19% of the productive forestland within the Rim Fire perimeter would still remain in chaparral, which is greater than the 16.2% reported by Show and Kotok (1924) on the Stanislaus in the 1920s.

101. Comment: Requiring thinning to 30 feet from all established oaks may not be appropriate on a site specific basis. We recommend stating an optimum number of individual and aggregated oaks (e.g., 5 per acre) and thinning conifers, based on future site-specific prescriptions, to assure an appropriate vegetative assemblage.

69

Response: Thinning around up to five oaks per acre (live trees or saplings greater than or equal to six inches dbh) on 1,164 acres within critical deer winter range was analyzed under all action alternatives (EIS, p.454-457). We have added language to Chapter 2, Deer Habitat Enhancement (p. 20) to clarify surviving oaks greater than or equal to six inches dbh would be targeted for release, removing any conifer within 30 feet of the bole of up to 5 oaks per acre.

102. Comment: Injecting heterogeneity into existing plantations is being proposed by implementing an ICO prescription. However, it is also being proposed that conifer trees in these same plantations would be thinned on a 22 to 28 foot spacing. These objectives are incompatible because thinning using an individual tree spacing criteria would result in homogeneity at the fine within-stand scale and create barriers to creating heterogeneity at the coarse within-stand scale. We ask that you remove the individual tree spacing requirement when thinning existing plantations to allow for a true ICO prescription. We suggest thinning and burning in existing plantations to create heterogeneity that do not include a tree spacing guideline. Since we are not aware of any attempts on the west-side of the Sierra Nevada to thin plantations in a manner that would create within-stand heterogeneity, such efforts should rely on adaptive management principles. A post-treatment analysis of thinning the first few plantations should be completed and adjustments made if the results are not consistent with the objectives. If such an approach cannot be used to result in true ICO conditions, then a marking prescription should be implemented that follows the principles of North et al. (2009).

142 241

Response: Individual trees are an integral component of the ICO structure (Individuals, Clumps and Openings). The EIS cites research conducted on the Stanislaus that quantified the historic ICO structure of mature mixed-conifer stands. The Forest Service used this research to guide development of the ICO thinning prescription (p. 10-11, 23). Lydersen et al. (2013) estimated that individual trees comprised between 5.6 and 12.6% of all trees in a stand and on average were spaced between 21.0 and 28.5 feet apart among various sizes of tree clumps and openings (Table 1.03-1). While the thinning prescription calls for thinning individual trees to a spacing of 22 to 28 feet apart, it also calls for creating an average of 8 clumps of leave trees per acre that range in size from 8 to 15 trees per clump; similar to that reported by Lydersen et al. (2013). The prescription also calls for an average spacing of 30 feet between clumps and individual trees. Additional small openings would be created by removing all conifers within 30 feet of established oaks or other hardwoods. North et al. (2009) explains that ridgetops typically had lower tree densities. The ICO thinning prescription mimics this by increasing the average tree spacing to 30 feet on primary ridges and fuelbreaks and creating periodic large openings that can serve as helispots (p. 23). Additionally, prescribed fire is proposed in all existing plantations and when possible would be implemented prior to mechanical thinning (p. 23). Finally, given the variability of low to moderate burn severities that occurred in the majority of the existing plantations, many have begun to exhibit an ICO structure, so thinning would focus on enhancing this structure while also reducing fuel loading (p. 10, 14).

103. Comment: More perplexing is the unit K018B that is proposed for thinning with the objective of making the forest more fire resilient. This area was burned during the Rim Fire at low-intensity as can been seen by the fire scars on some of the conifers, the dead saplings, and the burned log. We do not know the logging/tree planting history of this area, but it is clear that this area represents one of the low-intensity patches with larger conifers that can contribute to a future old-growth forest community. This patch represents the kind of conifer "clustering" necessary to provide the diversity of habitat the DEIS indicates is an important objective. Directly across the dirt road, looking south, however, is an extremely dense, monotypic pine tree plantation that represents a significant fire threat. No treatment is proposed for this area in the DEIS. While we support the thinning of pine tree plantations as proposed in the DEIS, like the areas west of Cherry Lake, we question the decision-making process when dense tree plantations remain while biodiverse, pre-old-growth tree clusters are proposed for treatment.

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Response: The Rim Reforestation project area is relatively large (over 154,000 acres), so it is possible that some existing plantations that survived the Rim Fire were overlooked during the planning process. The pine plantation described in the comment is not being proposed for thinning primarily because it is a small patch of trees (less than 1 acre) surrounded by canopy openings and tree clumps of various sizes. The older patch of trees located in unit K018B across the road to the north is a remnant patch of trees that survived both the Granite Fire and Rim Fire; however, this patch is surrounded by pine plantation established prior to the Rim Fire. Additionally, unit K018B is a relatively large unit (170 acres) and the remnant patch of trees is less than 5 acres, so this remnant patch is not representative of the entire unit. While some smaller live and dead trees may be removed from within and around these patches, the objective in these plantations is to reduce the fuel load and re-establish open canopy conditions to safely reintroduce fire (EIS, p. 10). The majority of the trees in the remnant patch would likely be retained to contribute to structural heterogeneity within the larger 170 acre unit while thinning would focus on the denser patches of live and dead smaller ponderosa pine trees around the edges of the patch and throughout unit K018B to promote a more resilient ICO structure with lower tree densities and reduced fuel loading.

WATERSHED

104. Comment: We support limiting conifer encroachment into meadows, although the planting patterns after the first 25 feet of exclusion appear complicated. We recommend creating the vegetative pattern during future thinning and not as an ICO planting pattern (Alternative 5).

84

Response: The Responsible Official will consider all specific written comments prior to making a decision to select any alternative or a combination of activates from other alternatives (1.06 Decision Framework).

105. Comment: We investigated Rim Fire impacts and basically agree with the USFS watershed evaluation, especially the first paragraph (DEIS, p. 311). Most observed soil movement resulted from rill and sheet erosion. This is being naturally mitigated by vegetative regrowth, although we prefer reforestation with a managed forest for long term erosion control. Much of the rill and sheet erosion remains in ephemeral watercourses and may re-suspend during heavy precipitation, as will deposited sedimentation on the bottom of the perennial watercourses.

97

Response: The EIS (p. 330) acknowledges hydrologic and erosional responses to the fire would continue to occur. The No Action alternative discloses the effects on long-term watershed stability and function of riparian communities and adjacent hillslopes (p. 330). As stated, stream condition is expected to continue to be affected by post-fire erosion and sedimentation though the magnitude is uncertain, and is largely dependent upon winter weather events (p. 311). Water quality degradation from erosion and sedimentation depends on rainfall intensity, steepness of hillslope, soil type, ground cover and other factors (p. 313). The proposed activities analyzed under the action alternatives show only minor effects to the recovery of this landscape.

106. Comment: There are some meadows with a ring of small live trees around the meadow where the fire intensity was low and not sufficient to kill the encroaching trees. Discussions with USFS staff indicate that meadow delineation will be conducted visually. Given that the majority of meadows were previously encroached, it is possible that current vegetation and other visible cues may not represent the previous meadow footprint. We recommend a wider no-tree buffer be established around meadows, from 25 feet to 75 feet, as needed. This will allow for meadow expansion, and provide an opportunity where these meadows can be enlarged back to their original size.

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Response: The Forest Service developed the proposed meadow buffer designs to reduce the potential for conifer encroachment while providing important meadow-edge wildlife habitat characteristics (EIS, p. 390) and retaining a source for future large woody debris, which can contribute to meadow hydrologic stability and nutrient dynamics (EIS, p. 526; Watershed Report, p. 316). Moving the no planting buffer beyond 25 feet would not meet those needs. In addition, future meadow restoration projects could address conifer encroachment on a site specific basis if trees began to impact meadow function.

WILDLIFE

107. Comment: Clearance of chaparral has been recently suspected of facilitating the spread of Lyme disease in vertebrates (Newman et al. 2015).

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Response: Newman et al (2015) reports that chaparral habitat yielded the lowest prevalence of larval and nymph ticks on birds within the study area. They further state that rapid shifts in California bird community structures toward locally increased abundances of some known carriers of Lyme disease (e.g., American robin and dark-eyed juncos) resulting from urbanization and chaparral removal represent changes in local disease ecology dynamics, potentially increasing transmission of Lyme disease to humans. This project does not propose to urbanize or remove any pre-fire chaparral habitat; therefore, it is not expected to shift bird community structures within the project area based on proposed treatments (EIS, p. 24-38).

108. Comment: Snags are an important wildlife component and are listed in the Project with retention standards. We recommend the Project clarify that not all snags are equal in value to wildlife. In restoration units where salvage operations have or will occur, we recommend the USFS maintain an average snag density of no less than 10 snags per acre, emphasizing retention of snags >20 inches dbh, and that snags be retained in a mosaic fashion, rather than in uniform distribution.

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Response: Snags are an important wildlife component at the stand and landscape scale. Snag levels and standards for the salvage logging operations were addressed under the 2014Rim Recovery EIS and ROD. For this project, the spotted owl, great gray owl, northern goshawk, marten, fisher and bat sections of the EIS (3.16 Wildlife) discuss species specific snag requirements (e.g., size and number per acre). While snag retention was not considered as an indicator for species other than bats in the project analysis, the benefits of snags are discussed under the Habitat Modification section for each of the aforementioned species (EIS, p. 372-376, 378, 387-388, 390, 396, 398, 406-408, 416-419, 427-430, 444-448). Management Requirements state the largest snags available would be targeted for retention. The Terrestrial BE (p. 14-15) provides additional clarification and assumptions that expand on the language used in the EIS (p. 43) regarding snag retention in Old Forest Emphasis and spotted owl Home Range Core Areas.

Black-backed Woodpecker

109. Comment: The DEIS misrepresents cumulative effects to BBWO by failing to include acres of suitable BBWO habitat already removed in Rim post-fire logging project, thereby reporting much higher BBWO habitat (and pair) retention on Stanislaus National Forest lands in the Rim fire than is actual, and thereby improperly minimizes adverse cumulative impacts to BBWOs. Specifically, the DEIS (p. 441) states that there are 10,326 acres of BBWO suitable habitat on the Stanislaus National Forest within the Rim fire, and that 2,260 acres of this, or about 22%, would be affected by the proposed action, claiming that over three-quarters of the BBWO pairs would be retained on the Stanislaus National Forest (see DEIS, p. 444). The DEIS further claims, in the Cumulative Effects section, that “cumulatively” 94% of the BBWO pairs would be retained by the Proposed Action, when suitable habitat in Yosemite National Park is included, based on the DEIS’s assessment of 17,487 acres of suitable BBWO habitat in Yosemite National Park (DEIS, p. 441). In the summary of the Cumulative Effects analysis, the DEIS claims that the 2,260 acres of suitable habitat that would be removed by the Proposed Action represent a total cumulative impact to BBWOs of only 8% loss of suitable habitat, out of a total of 27,813 acres in the Rim fire. However, the 2014 Rim Fire “Recovery” Final EIS (p. 416) states clearly that the Rim fire created 51,182 acres of suitable habitat, including the more than 17,000 acres in Yosemite National Park, 6,061 acres on private lands, and 27,617 acres on the Stanislaus National Forest. The Recovery EIS (p. 420) states that the 2014 Hazard Tree EA resulted in the removal of 2,370 acres of suitable BBWO habitat, roadside hazard tree felling in Yosemite National Park resulted in loss of 43 acres of BBWO habitat, and all 6,061 acres of suitable BBWO habitat on private lands have been lost to post-fire logging. Therefore, the 8,066 acres of suitable BBWO habitat that would remain on the Stanislaus National Forest after the Proposed Action is implemented (DEIS, p. 444) does not represent 78% cumulative retention of BBWO suitable habitat on Stanislaus National Forest lands in the Rim fire but, rather, represents only 29% cumulative retention of BBWO habitat on the Stanislaus National Forest, and the total cumulative retention of BBWO habitat, when all lands are included, is not 92%, as the DEIS claims (p. 445) but, rather, is only 8,066 acres (Stanislaus National Forest) plus 17,487 acres (Yosemite National Park) – i.e., only 25,553 acres out of the 51,182 acres (49.9%) of suitable BBWO habitat created by the Rim fire. This failure to honestly and fully analyze the cumulative effects of the Proposed Action to BBWOs, and the sleight of hand employed to create the appearance of very high levels of BBWO habitat/pair retention and very low cumulative losses of BBWO habitat/pairs, violates NEPA's hard look standard, and does so to such a profound degree that the DEIS must be withdrawn, reanalyzed, and re-submitted for public comment so the public can properly comment on and vet an actual, accurate, and complete analysis of cumulative effects to BBWOs. If the Forest Service moves forward with this seriously flawed EIS on the Reforestation project, both the Reforestation EIS and the Recovery EIS will then be in violation of NEPA for failure to divulge cumulative effects to BBWOs, given that neither divulged the full combined impact of the 2014 decisions (Hazard Tree EA and Recovery EIS) and the Reforestation EIS, plus loss of BBWO habitat on private lands, and the Forest Service plans to continue to implement the 2014 Recovery EIS and ROD in 2016 and beyond. Nowhere can the actual, complete cumulative effects analysis be found, including in the Cumulative Effects appendix of the Reforestation DEIS (App. B) and, because the reforestation DEIS analyzes impacts to BBWOs in the context of a flawed and incomplete assessment of BBWO cumulative habitat losses, none of the effects/impacts determinations are valid.

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Response: The commenter is correct that 51,182 acres of suitable black-backed woodpecker habitat was created by the Rim Fire, including 17,461 acres in Yosemite National Park, 6,061 acres on private lands, and 27,617 acres on NFS lands (USDA 2014). As stated in the Rim Recovery EIS (p. 425) the Rim Hazard Tree project resulted in the removal of 2,370 acres of suitable black-backed woodpecker habitat on NFS lands (USDA 2014h), the removal of hazard trees in Yosemite resulted in the loss of 43 acres of suitable habitat on NPS lands, and 6,061 acres of suitable habitat was removed on private lands (USDA 2014). The remaining habitat within the Rim Fire after these projects were implemented was about 42,750 acres or 8% of the habitat remained. About 25.300 acres of habitat remained on NFS lands.

The Rim Fire Recovery project decision approved the salvage, fuels treatment, and hazard tree removal on about 15,000 acres of suitable black-backed woodpecker habitat (USDA 2014). About 4,000 acres have been treated under the Rim Recovery as of March 2016. The remaining 11,000 acres is either currently under contract or will be treated in the near future. The remaining habitat on NFS lands after the Rim Recovery project is implemented will be 10,326 acres.

To better aid the public in understanding how the Forest Service conducted its analysis for black-backed woodpeckers, the reader should be aware that about 11,000 acres of suitable habitat will be treated under the Rim Recovery (salvage) project. These 11,000 acres will be treated whether or not the Rim Reforestation project is implemented; therefore, they were not analyzed as being suitable habitat under the direct and indirect effects analysis for the Rim Reforestation project. The Forest Service considers all past actions implemented as of March 2016 as part of the existing condition (2,370 Rim Hazard Tree project, 4,000 acres Rim Recovery project, 43 acres of hazard trees in Yosemite National Park and 6,061 acres on private land) and the remaining 11,000 acres as present actions for the cumulative effects analysis (EIS, p. 449). The Forest Service utilized the remaining 10,326 acres of suitable habitat on NFS land for calculations in the analysis reported under direct and indirect effects in this project (Rim Reforestation).

This acreage was used to assess the effects of the Rim Reforestation project on suitable habitat and it establishes a no action baseline that will likely exist even if this project is not implemented. If a higher baseline acreage had been used as suggested in the comment, the impacts from this project, Reforestation, would have been under estimated in the analysis.

110. Comment: The DEIS misrepresents NatureServe conservation threat ranking information and improperly minimizes impacts to BBWOs in this respect. The DEIS (p. 439) cites to an outdated IUCN assessment which does not take into account the fact that the California/Oregon population of BBWOs is a genetically distinct subspecies, which has a far smaller population than the global population assumed by IUCN. Similarly, the DEIS cites to outdated information regarding NatureServe's global ranking and national ranking for BBWO, once again avoiding recognition of the isolated, and much smaller, subspecies in CA/OR that would be affected by the Proposed Action. Due in great part to the actions of the Forest Service, in California the black-backed woodpecker is now ranked as "S2" or "Imperiled" (https://map.dfg.ca.gov/rarefind/view/QuickElementListView.html). This ranking is defined by NatureServe as follows: "Imperiled: Imperiled in the . . . state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the … state/province." (http://explorer.natureserve.org/nsranks.htm).

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Response: The NatureServe website (http://explorer.natureserve.org) was accessed November 09, 2015. The most current threat ranking available on that website is G5 (demonstrably secure) at the global level and N4 (apparently secure) at the national level. The state/province threat status indicates the California ranking is S3/S4 (vulnerable/apparently secure). The CDFW website was queried and indicates that as of January 2016 this species is ranked by the State as S2 (imperiled). This information has been added to the project record (EIS, p. 443).

111. Comment: On p. 440 the DEIS mentions that Siegel et al. (2015) indicates that BBWO populations have decreased in recent years in burned forests, but omits mention of the steep recent population decline in unburned forests which, when combined with the acknowledgement of an apparent decline in burned forests in the Sierra Nevada, creates a situation wherein proposed logging of BBWO habitat results in a much larger, compounded impact than the DEIS admits. Specifically, new information indicates that Black-backed Woodpecker populations are declining generally in the Sierra Nevada. Appendix A of Roberts et al. (2015), which was conducted for the Forest Service by Point Blue Conservation, found that a "sharp decrease" in BBWO populations is occurring in unburned forests throughout the Sierra Nevada in recent years (see Roberts et al. 2015, p. 39), and concluded that the data indicate a "strong change in green forest occupancy" appears to be occurring (Roberts et al. 2015, p. 40, and Figure A.1, p. 42). Roberts et al. (2015), Appendix A (p. 39-42), hypothesized that BBWOs that previously occurred in unburned forest may have been increasingly moving into burned forest in recent years, as the last three years have had above-average fire amounts. Given this, for populations to be stable overall (in the face of declining populations in unburned forest), occupancy would have to increase substantially in burned forest recently. However, this is not the case; in a separate study conducted for the Forest Service by the Institute for Bird Populations specifically in burned forest, the authors found that occupancy in 2013 and 2014 were the lowest since the study began in 2009, and 2014 was the lowest year of all (Siegel et al. 2015, p. 2). Neither Roberts et al. (2015) nor Siegel et al. (2015) assessed their results in light of the other, so neither had the complete picture in terms of current BBWO population trends in the Sierra Nevada. The current declines are consistent with projections of Odion and Hanson (2013), given the amount of BBWO habitat that has been logged in recent fires (about 50%, or more, in the 2013 fires: Rim fire, American fire, and Aspen fire, e.g.).

332 333

Response: The commenter's conclusions regarding Roberts et al. (2015) are speculative, and as stated above, is presented as a hypothesis by the author. As the commenter pointed out, "Neither Roberts et al. (2015) nor Siegel et al. (2015) assessed their results in light of the other." The findings and, more importantly, the discussions related to those findings are consistent in indicating that reduced occupancy within green forests or burned forests may be the result of individual black-backed woodpeckers vacating previously occupied home ranges to take advantage of recently burned areas. The authors of the Robert's study did not imply that the observed declines in occupancy were anything more than as stated, that individual woodpeckers vacated previously held home ranges to take advantage of recently burned areas, and did not imply that the species was in jeopardy. The commenter's suggestion that this study indicates a heightened concern regarding the status of the species' population is not supported.

It cannot be concluded that proposed project actions would adversely affect black-backed woodpecker populations that may inhabit unburned forests. At least 50% (about 25,600 to 27,800 acres) of the suitable habitat created by the Rim Fire would be retained under all action alternatives considered for this project. Based on survey results within the Rim Fire, available habitat is not currently saturated, and black-backed woodpeckers could utilize untreated areas. This species has the ability to disperse from occupied home ranges within green or burned forest habitat in order to take advantage of and colonize suitable habitat.

Given this recognized ability to colonize new areas, individual woodpeckers that may be displaced by removal of suitable habitat should be able to find other suitable habitat within untreated portions of the fire area as well as within other fires or nearby green forest. No evidence exists to suggest that woodpeckers displaced by the removal of suitable habitat would simply die.

Several years of data are required to see if a population pattern is experiencing variability or if it is undergoing a true decline. Siegel et al. (2015) stated, "… the proportion of occupied fires has remained constant. While the significantly lower point-level occupancy in 2014 indicates that overall abundance of black- backed woodpeckers was lower that year, this does not yet indicate a declining population trend" (p. 2-3). Given the confidence index in these model estimates it is not enough to conclude that the population is going through a real decline. Other factors associated with black-backed woodpeckers in green and burned forests, such as fecundity and dispersal dynamics using marked individuals, need to be incorporated before making inferences about the stability of black-backed woodpecker populations within them.

112. Comment: The DEIS contains an inadequate analysis of effects and cumulative effects of logging in BBWO habitat in nesting season, contrary to recommendations of the BBWO Conservation Strategy (Bond et al. 2012), and the one-sentence acknowledgement that BBWOs could be directly killed by this (p. 443) and the extremely brief mention that the proposed action does not conform to the recommendations of the BBWO Conservation Strategy (p. 448) are nowhere near adequate to address the serious impacts and cumulative effects of this proposal on BBWO populations, and the potential direct killing of chicks in the nest that cannot yet fly, under NEPA's hard look standard.

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Response: The EIS (p. 442-451) provides a detailed analysis of direct, indirect and cumulative effects to black-backed woodpeckers expected from all alternatives considered in detail.

California Spotted Owl

113. Comment: We fundamentally disagree with the empirically-unsupported hypothesis that California spotted owls would benefit from the reforestation methods proposed in Alternatives 1 and 5. The Forest Service almost always suggests that industrial reforestation methods are necessary to reach "old-forest" desired future conditions sooner than less-intensive reforestation methods to benefit the California spotted owl. However, we have yet to see any area reforested by the Forest Service in the Sierra Nevada using methods similar to those proposed in Alternatives 1 and 5 (i.e., 300 plus trees per acre planted over thousands of acres) result in high quality California spotted owl habitat (i.e., multi-aged and multi-canopied forest dominated by large trees), including plantations established more than 80 years ago (i.e., within the long-term time horizon on which this DEIS is based). Again, we have yet to see the Forest Service even attempt to inject heterogeneity into plantations anywhere on the west side of the Sierra Nevada. California spotted owls have been found to select against industrially reforested areas for foraging, even at rotation age (Irwin et al. 2015); yet, they have been found to select for complex early seral forests for foraging (Bond et al. 2009). Therefore, it is reasonable to conclude that reforested areas will result in a long-term loss of complex early seral foraging habitat with no evidence that such areas will ever support high quality spotted owl foraging, nesting, or roosting habitat.

143 171 242

Response: The Forest Service found little empirical evidence showing spotted owls selecting for or against plantations on NFS lands. One publication was found, Call et al. (1992), who recorded less than 2% of their telemetry locations of spotted owls within clearcut/shrub/plantation habitat on NFS lands, represented by tree size classes 0-12.9 centimeters dbh. The observed frequencies and sample size were too small to include in the analysis, thus no conclusions related to the selection for or against plantations was made. Studies related to habitat use of spotted owls on managed private timber lands was found (e.g., Diller and Thome 1999; Folliard et al. 2000; Thome et al. 1999), but does not reflect the vegetation composition in the Sierra Nevada or the management practices of the Forest Service and were not considered further. Irwin (2015) looked at short-term responses of spotted owls to various harvesting practices within young and mid-seral forested stands less than 80 years old, which is not relevant to this project. The Forest Service relied on growth modeling conducted for this project as a relative measure of effects among alternatives and related that to spotted owl habitat requirements documented in the literature to support the analysis conclusions (EIS, p. 374-384).

The commenters' suggestion that removal of complex early seral habitat would result in a long-term loss of foraging habitat is not supported by existing empirical data. Significant uncertainty exists regarding the extent to which spotted owls use burned forests (Manly 2014). There are studies that suggest spotted owls may use burned forests to forage in the short-term (Bond et al. 2009; Bond et al. 2010; Roberts et al. 2011; Lee et al. 2012; Bond et al. 2013; Lee et al. 2013), and other studies that indicate spotted owls do not select burned habitat for foraging (Clark 2007; Eyes 2014); however, uncertainties remain regarding long-term occupancy and demographic performance of spotted owls at burned sites (Keane 2014; Manley 2014). The reduction of about 2,200 acres of complex early seral habitat across the project area, as proposed under Alternatives 1, 3 and 5 may result in minor short-term negative impacts to spotted owls based on the current level of knowledge regarding spotted owl use of these habitat types. To date, no empirical evidence suggests that long-term negative impacts to owls would result from removal of this habitat. Spotted owls consistently use forested stands with greater: canopy cover, total live basal tree area, basal area of hardwoods and conifers, snag basal area and dead and downed wood, when compared to random locations for nesting, roosting and foraging (EIS, p. 373; Manley 2014). Empirical data consistently shows stands preferred by foraging owls consist of: at least 50 to 90% canopy cover at about 30 feet; at least two canopy layers; dominant and co-dominant trees averaging at least 11 inches dbh; total live tree basal area equal to 180 to 220 square feet per acre; total basal area of snags equal to 15 to 30 square feet per acre, higher than average levels of snags; at least 15 inches dbh and 20 feet tall; and downed woody debris averaging 10 to15 tons per acre, comprised of the largest logs (p. 373).

114. One of the Purpose and Needs identified for this project is to restore wildlife habitat and connectivity for species such as the spotted owl (p. 10). Spotted owls show the strongest associations with mature green forest conditions for nesting and roosting and habitat loss and fragmentation have been identified as significant risks to the distribution and abundance of this species across the Sierra Nevada (p. 373-375). Reforestation proposed under this project includes prescriptions that differ from historic reforestation efforts in several ways. Alternatives 1, 3 and 5 include consideration of slope position and aspect similar to that described in GTR 220 (North et al. 2009) and the EIS (p. 5). Alternative 1 has seven distinct planting designs (152 to 303 trees per acre), including oak buffers which would result in heterogeneity at the stand and landscape scales (p. 26-29). Within ten years of planting, the density of conifer trees is expected to decrease to an estimated 104 to 207 trees per acre (p. 261). In addition Alternatives 1 and 3 incorporate prescribed fire ten years after planting, which is expected to further reduce the number of trees per acre, accelerate residual tree growth, and contribute to stand and landscape heterogeneity and structure identified in the desired condition (p. 375). Under Alternative 5, one planting design is proposed (444 trees per acre), including oak buffers which would be followed up by thinning treatments as early as age seven to achieve the desired ICO structure or heterogeneity at the stand and landscape scales, also described in the desired condition (p. 375). The density of conifer trees under Alternative 5 is expected to decrease to an estimated 211 to 236 trees per acre at year ten (p. 284). Thinning to ICO is expected to further reduce the number of trees per acre, accelerate residual tree growth and contribute to stand and landscape heterogeneity and structure identified in the desired condition (p. 375). Herbaceous and understory vegetation would be retained during reforestation efforts on up to 20% of every unit, contributing to sustained cover and recruitment of understory vegetation which would contribute to within stand structure (p. 375). Project specific growth modeling (to 80 years) predicts Alternatives 1, 3 and 5 would provide more suitable habitat including more large trees (greater than 24 inches dbh) and higher levels of snag recruitment when compared to Alternatives 2 and 4 (p. 375-376). Snags and downed logs (biological legacies) proposed under all action alternatives contribute to the structure of future forest development and are important to prey species (p. 375-376). Specifically, microsite development as downed logs decay would facilitate hypogeous fungi growth (i.e., truffles), which serve as a primary food source for spotted owl prey – the northern flying squirrel in particular (p. 376). In summary, the growth modeling conducted using the proposed reforestation treatments under Alternatives 1, 3 and 5 predicts the development of more moderate and high capability habitat as early as 80 years post planting when compared to Alternatives 2 and 4. This data combined with the habitat requirements of the spotted owl support the conclusions that spotted owls would benefit from implementation of Alternatives 1, 3 and 5.**Comment**: The DEIS's assessment of impacts to California spotted owls is inadequate under NEPA. First, the DEIS (p. 371) relies upon Eyes (2014), which has been shown to have misrepresented the data and conclusions about the relationship between owls and high-severity fire patches by improperly classifying certain CESF areas that the owls were using as low/moderate-severity areas. When this error was corrected, it became clear that the owls were in fact using high-severity fire areas more than expected based upon availability (Bond and Hanson 2014 [the California spotted owl ESA listing Petition], p. 69 and Appendix A). Moreover, Eyes (2014) misrepresented Clark (2007) by claiming that spotted owls avoided high-severity fire areas when, in fact, the owls used high-severity fire areas in dense, mature forest more than expected based upon availability and avoided post-fire logged areas (Bond and Hanson 2014, p. 69).

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Response: The Forest Service considered Eyes (2014), Bond and Hanson (2014) and numerous other sources in the analysis of California spotted owls and their use of post-fire habitats (EIS, p. 371). There is significant uncertainty regarding the extent to which spotted owls use burned forests (Manly 2014). There are also uncertainties remaining with regards to long-term occupancy and demographic performance of spotted owls at burned sites (Keane 2014; Manley 2014).

115. **Comment**: The DEIS (p. 369) admits that California spotted owls are declining in forests where logging (including mechanical thinning and post-fire logging) occurs, but then claims that the cause of the decline is unknown, implying that mechanical thinning, and post-fire logging and associated shrub removal are not factors in this decline. This position is directly contradicted by the current science presented in Bond and Hanson (2014) (at p. 24-58 and 88-102) and in the US Fish and Wildlife Service's recent 90-day determination on the Bond and Hanson (2014) ESA listing Petition for the California spotted owl. On 9/18/15, the U.S. Fish and Wildlife Service issued a determination that, based upon the Petition by Bond and Hanson (2014) (attached), listing the California Spotted

Owl under the Endangered Species Act “may be warranted”. Here are a few highlights from USFWS's recent 90-day determination:

1. With regard to Factor A (threat to the species due to habitat loss/destruction), FWS (p. 2) listed "thinning, and post fire salvage logging" as primary threats. In the context of concluding that removal of post-fire habitat is a threat to the owls, FWS noted that post-fire habitat is important/beneficial to spotted owls, concluding: "Recent research has focused on use of burned forests by CSO and has concluded that unlogged burned areas may be important to reproductive success and continued occupancy." FWS identifies logging (which includes post-fire logging, thinning, and clearcutting) as the major source of the owl's population decline, concluding: "The petitioner cites over 150 references, a number of which are related to all timber harvest types, decreased use by CSO and data driven measurement of curtailment of the range and/or reduction in reproducing owl pairs."
2. With regard to Factor D (inadequacy of existing protections), FWS (p. 4) agreed with the Petition that the Forest Service's "2004 Framework" forest plan, and more recent forest plan revisions, represent a threat to the California Spotted Owl, noting the reasons for their conclusion: "2004a USDA. This amendment to the 2001 US Forest Service Forest Plans (USDA 2001) allowed increased or new timber harvest, thinning, fuels reduction, post fire logging, etc. in areas previously managed for CSO. USDA 2013b. Management in the Lake Tahoe Basin Management Unit allows clear cut timber harvest and removal of larger diameter trees (>30 inches dbh) in CSO habitat and previously occupied nest areas."
3. With regard to Factor E (other issues), FWS (pp. 4-5) agreed with the Petition that California Spotted Owl populations are indeed now declining, and notes that the population is now so small that it has an "impoverished gene pool". FWS further agrees with the Petition that California Spotted Owl habitat loss and fragmentation caused by logging "can exacerbate" the threats to the owls from climate change.

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Response: The EIS (p. 372) summarizes current population trend research and states there is increasing empirical evidence that California spotted owl population trends indicate population declines on three demographic study areas on NFS land (Conner et al. 2013; Tempel and Gutierrez 2013; Tempel et al. 2014). These publications do not provide empirical evidence to elucidate the factors driving the current population trends. They do however recognize the need for further research to identify the factors affecting population trends. This analysis does not contradict USFWS (2015c) docket (FWS-RS-ES-2015-0139) or the USFWS 90-day petition findings (80 Federal Register 181, September 18, 2015; p. 56423-56432). The information supplied by the commenter are not conclusions made by FWS, they are simply summaries of the information provided from the petition.

Federal Docket No. FWS-RS-ES-2015-0139 includes a USFWS review of the information provided in the petition submitted by Bond and Hanson (2014) in order to conduct a 90-day finding. Nothing in the aforementioned docket shows USFWS “findings” or “agreements” as claimed by the commenter:

7. What did the Service consider in reaching its conclusion and finding? "In making this finding, the Service evaluated the information (emphasis added) provided by the petitioners. The process of coming to a 90-day finding is limited to a determination of whether the information provided in the petition(s), supporting information submitted with the petition(s), and information otherwise available in Service files meets the "substantial information" threshold. The Service does not conduct additional research at this point, nor does the Service subject the petition(s) to rigorous critical review or solicit information from parties outside the Service."

13. How does a positive finding for the owl and salamanders affect dam construction, timber harvests and other land management activities? "This positive 90-day finding does not

> change the status of the species (emphasis added). A positive finding does not mean that the Service has decided to grant federal protections for the species. A positive 90-day finding means only that the Service determined the petition presented (emphasis added) substantial scientific information to indicate that the action may be warranted (emphasis added). At that time, the Service begins a comprehensive review of the status of the species."

In addition, USFWS published their California spotted owl determination in the Federal Register Notice for Endangered and Threatened Wildlife and Plants; 90-Day Findings on 25 Petitions (80 Federal Register 181, September 18, 2015; p. 56423-56432): "Based on our review of the petitions and sources cited in the petitions, we find that the petitions present substantial scientific or commercial information indicating that the petitioned action may be warranted (emphasis added) for the California spotted owl (*Strix occidentalis occidentalis*) based on Factors A, D, and E. However, during our status review, we will thoroughly evaluate all potential threats to the species." (p. 56426). The USFWS review includes subjecting the petition to rigorous critical review, and soliciting additional information from parties outside the agency.

116. **Comment**: Though the DEIS (p. 373) admits that California spotted owls often select high-severity fire areas, defined by high density of snags and high shrub cover (Bond et al. 2009), due to an enhanced small mammal prey base, the DEIS (p. 374-377) completely fails to include analysis of the degree of impacts to this habitat from proposed removal of both the snag component and the shrub component of CESF, as well as from mechanical thinning, across thousands of acres within the biological home ranges of spotted owls in the Rim fire. As the Bond and Hanson (2014) Petition establishes in detail (at p. 91-103 and appendices), post-fire logging and associated shrub removal and artificial tree plantation establishment are significant threats to spotted owls, as is mechanical thinning.

338

Response: Significant uncertainty exists regarding the extent to which spotted owls use burned forests (Manly 2014). Some studies suggest spotted owls may use burned forests to forage in the short-term (Bond et al. 2009; Bond et al. 2010; Roberts et al. 2011; Lee et al. 2012; Bond et al. 2013; Lee et al. 2013), and other studies indicate spotted owls do not select burned habitat for foraging (Clark 2007; Eyes 2014). Under Alternatives 1, 3 and 5 about 121 acres of complex early seral habitat are proposed for reforestation treatments within 19 spotted owl HRCAs. Outside of spotted owl HRCAs, Alternatives 1, 3 and 5 propose reforesting about 2,100 acres of complex early seral habitat. The reduction of about 2,200 acres of complex early seral habitat may result in minor short-term negative impacts to spotted owls. Long-term occupancy and demographic performance of spotted owls at burned sites is largely unknown and requires further study (Keane 2014; Manley 2014). About 8,000 acres of complex early seral habitat would be retained on NFS lands and would continue to provide potential foraging benefits to spotted owls. An additional 17,500 acres of complex early seral habitat remains available to spotted owls on National Park Service lands within the analysis area.

Spotted owls show the strongest associations with mature forest conditions for nesting and roosting but will forage in a broader range of vegetation types (EIS, p. 371). While green forested habitat has been greatly reduced within the Rim Fire area, about 40,000 acres of remaining suitable habitat is still available (p. 370). This green forest habitat remains available within spotted owl breeding territories and HRCAs, including adjacent to treatment units (p. 375). Numerous studies are available regarding spotted owl's use of green forest habitat for foraging. Owls are documented to consistently use stands with: at least 50 to 90% canopy cover at about 30 feet, at least two canopy layers, dominant and co-dominant trees averaging at least 11 inches dbh, total live tree basal area equal to 180 to 220 square feet per acre, total basal area of snags equal to 15 to 30 square feet per acre, higher than average levels of snags, at least 15 inches dbh and 20 feet tall and downed woody debris averaging 10 to15 tons per acre, comprised of the largest logs (p. 373). Thus, green forest habitat available in the project area is critical and will continue to provide foraging habitat for owls.

Project design criteria promote heterogeneity when planting or pre-commercially thinning conifers (p. 375). For example, up to 5 oaks per acre would receive a 25 foot radius buffer to provide ample growing space in the long-term. Up to 20% understory vegetative cover would be retained on a unit basis and would not be treated during site preparation or release. Other inoperable areas, such as steep pitches and sensitive plant sites would not be planted with conifers. These design criteria would break up the continuity of planted conifers, promote several open grown oaks per acre and would provide understory vegetation throughout the treated areas (p. 375). Snags and down woody material will function as habitat elements important for owl prey. Snags also serve as potential hunting perch sites that may be utilized by foraging owls. With these design criteria in place, treatment units will provide some foraging habitat for owls when in close proximity to green forest.

Direct, indirect, and cumulative effects regarding thinning of existing plantations (mechanical thinning) is provided for all alternatives considered in detail (p. 375-380).

The petition the commenter references (Bond and Hanson 2014) has not gone through the 12 month review by FWS, which will include additional research, subjecting the petition to rigorous critical review and solicitation of additional information from parties outside the agency. To date, FWS has only determined that the petition presented substantial scientific or commercial information indicating that the petitioned action may be warranted (emphasis added) for the California spotted owl (Strix occidentalis occidentalis) based on Factors A, D, and E (80 Federal Register 181, September 18, 2015; p. 56423-56432). This positive 90-day finding does not change the status of the California spotted owl.

Great Gray Owl

117. Comment: Studies have found that the majority of GGO nest sites are located within 600 feet of meadow edges (Winter 1980). Meadows, meadow complexes, and adjacent timber stands in the Project area may be highly suitable GGO foraging, roosting and nesting habitat. Maintaining and enhancing these areas in a condition that can support the foraging and roosting needs of GGO breeding pairs and in a condition that provides potential future nesting sites for expanding local populations is an important component of statewide GGO conservation. We recommend that restoration efforts within 600 feet from the meadow edge, around meadows or complexes of meadows totaling 10 acres or more, are limited to those necessary to enhance and maintain GGO habitat per Beck and Craig's 1991 Habitat Suitability Index model. We support the USFS proposal of installing artificial nest structures, not as permanent solutions, but as temporary measures to maintain site occupancy until suitable natural nest sites become available again. Further, we recommend the retention of understory cover or low hanging limbs since they can be used as climbing opportunities or cover from predators by fledging GGOs who might not be fully capable of flight.

251

Response: Restoration efforts near and adjacent to meadow habitat are consistent with Beck and Craig (1991). These consistencies include retaining up to 6 snags per acre, promoting forest cover near and adjacent to meadows through reforestation, and thinning plantations to promote accelerated tree growth and structural heterogeneity. The proposed treatments are expected to benefit great gray owls in the short and long-term (EIS, p. 389-394).

118. Comment: We recommend the limited operating period (LOP) for GGO, of March 1 through August 15, be extended through September 30, which would encompass the time that young disperse from nest stands. Alternatively, we recommend that LOP be maintained until young have fledged, and that it is only lifted after a qualified biologist has determined that the birds have fledged and are no longer reliant upon the nest or parental care for survival.

252

Response: The LOP for great gray owls (March 1 through August 15) is consistent with the Forest Plan Direction (USDA 2010a) and is based on analysis in the Sierra Nevada Forest Plan Amendment (USDA 2001). This timeframe covers the typical nesting season (courtship to post-fledgling stage) for great gray owls in the Sierra Nevada. While young of the year will become independent late summer and disperse in the fall, they are fully mobile several weeks after fledging and would be capable of avoiding disturbances.

Management Indicator Species

119. Comment: The DEIS fails to include any analysis of adverse impacts to several Sierra Nevada Management Indicator Species that would be impacted by the proposal, including Yellow Warblers, Mountain Quail, Fox Sparrows, and Hairy Woodpeckers. This omission is serious, given that these species were chosen to represent larger groups of species with similar habitat requirements, and act as bellwethers for the health of those larger groups of species. The Forest Service's failure to analyze adverse impacts to these species violates NEPA.

230 328

Response: Yellow warblers and hairy woodpeckers were eliminated from detailed analysis because the habitat they represent (riparian and snags in green forest) would not be affected by the proposed project (MIS Report, p. 6). A detailed analysis of project effects to habitat is provided for fox sparrows, which represent west-slope chaparral (MIS Report, p. 8-12), and mountain quail which represent early and mid-seral coniferous forest (MIS Report, p. 12-15). A detailed analysis of project effects to habitat is also provided for black-backed woodpeckers, which represent snags in burned forest (MIS Report, p. 15-18).

120. Comment: The DEIS fails to satisfy NEPA's hard look requirement by failing to analyze adverse impacts to bird species associated with complex early seral forest (CESF) habitat created by high-severity fire in forests, in light of the fact that these species are disproportionately in decline in the Sierra Nevada relative to birds associated with unburned mature forest (Hanson 2014), and in light of the proposal to remove additional thousands of acres of this habitat, including during nesting season when chicks—whether of shrub-nesting or cavity-nesting bird species – cannot fly away, creating a compounded adverse impact and an ecological trap scenario (Hanson 2014).

329

Response: The 2007 Sierra Nevada Management Indicator Species Amendment (project record) requires analysis of project effects to MIS habitats, which include complex early seral habitat.

Black-backed woodpeckers are an MIS species chosen to represent snags in burned forest, or complex early seral habitat, and other species that use burned forest habitat. This analysis is considered a proxy for other species that utilize snags in burned forest or complex early seral habitat; therefore, effects are analyzed for those species that are associated with this habitat type. Project effects have been analyzed and documented for this species in the BA/BE/Wildlife Report (p. 130-135) and project effects to habitat (i.e., snags in burned forest) haves been analyzed and documented in the MIS Report (p. 15-18). Fox sparrows are the MIS species chosen to represent chaparral habitat on the west-slope of the Sierra Nevada including montane chaparral, mixed chaparral, and chamise-redshank chaparral. This analysis is considered a proxy for other species that utilize chaparral habitat; therefore, effects are analyzed for those species that are associated with this habitat type. Project effects have been analyzed and documented in the MIS report (p. 8-12).

Mule Deer

121. Comment: Early successional areas comprised of montane and mixed chaparral and mixed conifers provide unique landscapes for biodiversity. In a study of mule deer winter ranges near Trinity Lake, Loft and Menke (1984) found that plots with the highest deer use had high cover of deerbrush

(*Ceanothus integerrimus*). Subsequently, deer use increased as hiding cover less than 0.5 m in height and deerbrush cover increased. Mule deer depend on hiding cover. Hiding cover increases as shrub vegetation increases. As such, statements found within the DEIS which falsely characterize chaparral habitats as ones which "impede wildlife movement" will not contribute to a future EIS based upon science. Rather, these statements are used to justify the clearance of native habitats.

227

Response: The Forest Service agrees that mule deer benefit from shrubs such as deerbrush, buckbrush and mountain mahogany for both forage and cover. Shrub fields do become overly dense with lack of fire or other management and become obstacles, impeding wildlife movement. Loft and Menke (1984) found that deerbrush cover along transmission line corridors averaged 29 to 40% and hiding cover (shrubs 0 to 0.5 m tall) resulted in higher deer use. Having 40% or less shrub cover allows for movement of ungulates such as deer. The critical deer winter range had shrub stands so dense prior to the Rim Fire that very few corridors were navigable by deer severely restricting access to the Jawbone Lava Flat, an important forage area (Marcie Baumbach, pers. obs.; pers. comm. Greg Gerstenberg CDFW). These corridors became predator chutes where mountain lions would lie in wait and predate deer on a regular basis (pers. comm. Greg Gerstenberg CDFW). Post-fire, sprouting and recruitment of shrubs has occurred throughout the critical winter range, providing both forage and hiding cover. This project would retain all pre-fire chaparral habitat across the critical winter range and within the project area. Prescribed fire is proposed to maintain the health and vigor of these areas within the critical winter range so deer can easily traverse the area and benefit from the forage and hiding cover that shrubs provide (EIS, p. 454-455). Within all reforestation units, the project would maintain up to 20% vegetative cover which would continue to provide cover and forage for deer and other wildlife species.

122. **Comment**: Chaparral shrubs provide important nutritional value. A study conducted within the Sierra National Forest found that deerbrush has high concentrations of calcium (Kie 1986). When combined with other browse species, deerbrush plays an important role in the nutrition of adult and fawn deer during summer months.

228

Response: The Forest Service agrees that deerbrush is an important source of forage for deer. No project activities are proposed within any critical deer summer range.

123. **Comment**: Between 2009 and the present, the Department has been conducting a deer research project within the footprint of the Rim Fire. Prior to 2013, the Department documented mortality during migration was high in areas that had burned and regrown into thick brush bands through migration routes. Predation mortality was minor adjacent to the brush bands in areas where brush was controlled or where no fire occurred. Providing a mosaic that allows brush for forage in some areas and maintaining hazard free migration areas is important in sustaining the deer population. Therefore, the Department supports herbicide brush treatment within the migration corridors in a way that will result in a habitat mosaic.

255

Response: Prescribed fire, expected to benefit deer, is proposed across the critical winter deer range in existing plantations under Alternatives 1, 3 and 5. The resulting mosaic would be similar to that described in the comment (EIS, p. 454-457). Prescribed fire, proposed in reforestation units across the project area under Alternatives 1 and 3, is expected to benefit the deer herd. Herbicide use was considered only for competing vegetation control in reforestation units and noxious weed control under Alternatives 1 and 5, not for shrub control along migration corridors. The prescribed fire proposed is considered the most effective for maintaining and promoting habitat heterogeneity across critical winter deer range.

124. Comment: The DEIS's analysis of impacts to mule deer utterly fails to divulge that mule deer preferentially select unmanaged complex early seral forest (CESF) habitat for foraging (Bond 2015), and fails to include any analysis of the adverse effect of the Proposed Action on CESF, given that the entire purpose of the proposal is to remove CESF and replace it as quickly as possible with mature conifer forest. Current data indicate that fire creates higher quality food for mule deer, and tends to increase reproductive rates and populations, while post-fire removal of snags and shrub habitat reduces mule deer use of areas (Bond 2015). While mature conifer forest provides certain types of habitat for mule deer, the removal of thousands of acres of the CESF habitat that they select to find the food they need to survive is a significant adverse impact and cumulative effect (Bond 2015), and the DEIS violates NEPA by avoiding disclosure of such habitat loss. Rather than doing a candid assessment of impacts, including adverse effects, to mule deer, the DEIS instead acts as a promoter of the Proposed Action, choosing to omit content about negative environmental effects to this species from both planned removal of the snag component of CESF as well as an even larger removal of the shrub component of CESF.

335

Response: The Forest Service acknowledges and agrees that deer utilize and benefit from post-fire effects resulting in resprouting or recruitment of new and more palatable herbaceous and woody vegetation in both chaparral and forest habitat. Bond (2015) is a chapter in a book, "The Ecological Importance of Mixed-Severity Fires-Natures Phoenix" (DellaSala and Hanson 2015), which provides an overview of published studies related to wildlife response to mixed and high severity fires. Literature cited in Bond (2015), such as Klinger et al. (1989), Roberts and Tiller (1985) and Smith (2000), support the hypothesis that, in the short-term, deer use increases after prescribed fire when appropriate cover is available, presumably due to the increased availability of palatable browse. With each year post-fire, declines in deer use were documented (Ibid). This is indicative of the reduced palatability as shrubs age and become more decadent and dense such that they can impede deer movement which has been observed within the project area (Gerstenberg unpublished data and pers. comm., personal observation). Davis (1977) reports that there was a significant relationship between deer use and the number of plant species present, showing a preference for a wide variety of forage species. He also reports that deer used both young burned areas and clearcut areas (where little or no standing timber was remaining), but did exhibit a preference for young burned areas with more standing timber. This study represents a short-term benefit realized by deer 5 and 9 years post-fire, before the standing timber fell, which likely impeded deer access to and movement through these stands. Salwasser and others (1982) suggest that optimal habitat structure for deer includes open conditions in vegetation under four feet to allow for deer movement.

Thousands of acres of chaparral and burned forest are not proposed for any type of treatment within the Rim Fire foot print including those that burned at low-moderate burn severity and that will provide benefits to deer. Thousands of acres (8,066 acres) of complex early seral habitat within the analysis area are not proposed for treatments and will continue to provide benefits to deer until excessive snag fall and shrub density increases, impeding deer movement through those areas. Project Management Requirements retain snags in all areas proposed for reforestation and within thinning units, up to six snags per acre and five downed logs per acre, providing cover and concealment (EIS, p. 43). Additionally retention of vegetation on up to 20% of each acre in reforestation units would continue to provide forage and cover for deer (p. 22). Thinning existing plantations would provide the benefits of increasing new and more palatable forage through increased light penetration and the release of oaks, a critical food source for mule deer (p. 452-457). Critical winter range was chosen as the focal area for mule deer analysis of project effects because critical winter range is where the highest concentrations of deer are found and where habitat condition directly affects the viability of the population (p. 453). No critical summer range exists within the project area. Within the critical winter range, very little complex early seral habitat remains. About 56 acres of complex early seral habitat is proposed for reforestation treatments in critical winter range and is not considered to present a significant impact to mule deer. About 195 acres of complex early seral habitat within critical winter range is not proposed for treatment and would continue to provide benefits for deer in the short-term as described above. No pre-fire chaparral habitat is proposed for reforestation, it is however proposed for prescribed fire which would allow us to manage for and maintain high quality forage and a navigable landscape throughout the critical winter range (p. 452-457). Additionally, noxious weed treatments proposed within critical winter range are expected to benefit deer by reducing or eradicating noxious weeds and promoting native grasses and forbs across about 3,100 acres (p. 454-457).

Table F.01-1 List of Respondents

LID	CID Start[1]	CID End[2]	CID Total[3]	LAST	FIRST	ORGANIZATION	TIMELY	DATE
1	1	5	5	Smith	Brian		Yes	12/2/2015
2	6	10	5	McGinnis	Patrick		Yes	12/2/2015
3	11	12	2	Vinzant	Larry	Federal Highway Administration	Yes	12/4/2015
4	13	34	22	Brink	Steve	California Forestry Association	Yes	12/23/2015
5	35	36	2	unknown	unknown		Yes	1/1/2016
6	37	37	1	unknown	unknown		Yes	1/3/2016
7	38	42	5	Ringen	Ron		Yes	1/4/2016
8	43	56	14	Jamar	Alicia	Tuolumne County Board of Supervisors	Yes	1/6/2016
9	57	57	1	Brown	Matthew	United States Department of the Interior	Yes	1/7/2016
10	58	105	48	Ramirez	Tim	San Francisco Public Utilities Commission	Yes	1/7/2016
11	106	113	8	Boze	Cathi	Mariposa County Agricultural Commission	Yes	1/7/2016
12	114	120	7	Hagen	Matt		Yes	1/7/2016
13	121	124	4	Gorman	Elaine		Yes	1/7/2016
14	125	129	5	Fiske	Leonard		Yes	1/8/2016
15	130	137	8	Kramarz	Ken	Tawonga Jewish Community Corporation	Yes	1/8/2016
16	138	144	7	Sturtevant	Jon	Tuolumne Group of the Sierra Club	Yes	1/9/2016
17	145	145	1	Rice	Kevin		Yes	1/10/2016
18	146	155	10	Little	Charles		Yes	1/10/2016
19	156	159	4	Crook	Shaun	Tuolumne County Farm Bureau	Yes	1/11/2016
20	160	166	7	Wayland	Brian	Sierra Pacific Industries	Yes	1/11/2016
21	167	176	10	Kruse	Walter	Central Sierra Audubon Society	Yes	1/11/2016
22	177	188	12	Hagen	Elaine		Yes	1/11/2016
23	189	202	14	Jensen	Jerry	American Forest Resource Council	Yes	1/11/2016
24	203	236	34	Halsey	Richard	California Chaparral Institute	Yes	1/11/2016
25	237	248	12	Solvesky	Ben	Sierra Forest Legacy	Yes	1/11/2016
26	249	261	13	Moua	Linda	California Department of Fish and Wildlife	Yes	1/11/2016
27	262	320	59	Buckley	John	Central Sierra Environmental Resource Center	Yes	1/11/2016
28	321	325	5	Munson	James	Environmental Protection Agency	Yes	1/11/2016
29	326	431	106	Hanson	Chad	John Muir Project-Center for Biological Diversity	Yes	1/11/2016
30	432	441	10	Sperling	Ruth		Yes	1/11/2016
31	442	459	18	Lott	Carolyn	Yosemite-Stanislaus Solutions	Yes	1/11/2016
32	460	469	10	Koepele	Patrick	Tuolumne River Trust	Yes	1/11/2016
33	470	472	3	Hutto	Richard		No	1/12/2016
34	473	476	4	Day	Kevin	Tuolumne Me-Wuk Tribal Council	Yes[4]	1/28/2016
		total	476					

CID=Comment ID (comment number in order received); LID=Letter ID (letter number in order received)

[1] First comment (CID) in letter

[2] Last comment (CID) in letter

[3] Total comments (CIDs) in letter

[4] Letter is timely because it documents comments provided during Federal-Tribal consultations as allowed pursuant to 36 CFR 218.5(b).