Rim Fire Reforestation Project

Groveland and Mi-Wok Ranger Districts
Stanislaus National Forest

Biological Evaluation*

Aquatics – Forest Service Sensitive Species

Biological Evaluation as supporting documentation for the Environmental Impact Statement

Prepared by:

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This biological evaluation (BE) meets the requirements of FSM 2672.4 and complies with 36 CFR 219.19 and 241.1.

*Adapted from Rim Fire Recovery Project fisheries report (USDA 2014)

Summary of determinations:

Species/Habitat	Status	Determination
Limestone salamander	Forest Service sensitive	No effect
California red-legged frog	Federally Threatened	May affect, likely to adversely affect
Sierra Nevada yellow-legged frog	Federally Endangered	May affect, likely to adversely affect
Foothill yellow-legged frog	Forest Service sensitive	May affect individuals, but not likely to lead to a trend in federal listing or loss of viability in the planning area
Western pond turtle	Forest Service sensitive	May affect individuals, but not likely to lead to a trend in federal listing or loss of viability in the planning area
Hardhead	Forest Service sensitive	May affect individuals, but not likely to lead to a trend in federal listing or loss of viability in the planning area

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PROJECT
Rim Fire Reforestation Project.

GENERAL LOCATION
The project area is located on the Groveland and Mi-Wok Ranger Districts of the Stanislaus National Forest in Mariposa and Tuolumne Counties, California. The project area is generally bounded on the south by Township 2 South, the north by Township 3 North, the east by Range 21 East, and the west by Range 16 East. The USGS Quadrangles include El Portal (4381), Kinsley (4382), Buckhorn Peak (4391), Groveland (4573), Jawbone Ridge (4574), Ascension Mountain (4563), Ackerson Mountain (4564), Lake Eleanor (4561), Cherry Lake South (4562), Duckwall Mountain (4571), Tuolumne (4752), Twain Harte (4743), Hull Creek (4744), Cherry Lake North (4733), and Kibbie Lake (4734). Elevation range of the project area is approximately 800 to 7,000 feet.

ENVIRONMENTAL SETTING
Major vegetation associations include oak grassland, chaparral, ponderosa pine, Sierran Mixed conifer. Aquatic features include springs, seeps, ponds, reservoirs, and ephemeral, intermittent, and perennial streams. Elevation range is approximately 1,000 feet to 7,000 feet.

PROJECT TYPE
Reforestation – mechanical site preparation, herbicide application, prescribed fire.

INTRODUCTION
The purpose of this Biological Evaluation (BE) is to review the Rim Reforestation Project and its suite of proposed actions on the Stanislaus National Forest, and evaluate the effects of the proposed alternatives on Forest Service Sensitive species (FSS). A determination is made as to whether any of the alternatives would lead to a trend in Federal listing or in a loss of viability in the planning area for any sensitive species. An additional document, a Biological Assessment, will be prepared for the selected alternative to document the anticipated effects of the proposed action on federally listed threatened, endangered, and proposed species, provide documentation of consultation with the U. S. Fish and Wildlife Service, and fulfill the requirements required by the Endangered Species Act and Forest Service Manual. Also, an analysis of effects to aquatic habitat arising from the alternatives is available in the management indicator species (MIS Report) prepared for the EIS.

This document tiers to the Stanislaus National Forest's Forest Plan Direction (USDA 2010a). The USDA (2001, Volume 3, Chapter 3, part 4 and Appendix R) and USDA (2004a) evaluated population viability concerns, relevant risk factors, and vulnerability for all species considered in this document. The considerations of this document included an evaluation of species occurrence, habitat, viability concerns, and risk factors as discussed in USDA 2001 FEIS and USDA 2004 SEIS in relation to the proposed

action for all aquatic fauna that are Federally-listed and USFS Region 5 Sensitive species. The analysis that was completed and detailed in these two documents is applicable at the range-wide scale of the species considered in this document and is incorporated into this analysis by reference. This Biological Evaluation defines the potential for effects to species at the project level scale and discusses the relevance of that potential to the species and their habitats.

CONSULTATION TO DATE

The Sacramento office of the US Fish and Wildlife Service was notified of the project in 2015, and initial consultation procedures are active as of November 2015.

An official list of Federal Endangered and Threatened Species covering the Ackerson Mountain, Cherry Lake North, Cherry Lake South, Duckwall Mountain, Groveland, Hull Creek, Jawbone Ridge, Lake Eleanor, and Tuolumne U.S.G.S. 7 ½ minute quadrangles was obtained from the Sacramento U.S. Fish and Wildlife Office website on December 5, 2013, updated on April 17, 2014 (Document 140417112513), and verified via IPac November 2015. The USFWS list was used as a basis for determining which species should be considered in the Biological Assessment (BA).

Excepting herbicide use, this project is expected to comply with the parameters set forth in the following document: *Programmatic Biological Opinion on Nine Forest Programs on Nine National Forests in the Sierra Nevada of California for the Endangered Sierra Nevada Yellow-legged Frog, Endangered Northern Distinct Population of Mountain Yellow-legged Frog, and Yosemite Toad (Service File FF08ESMF00-2014-F-0557* (USFWS 2014). Based on regional guidance (107-foot application buffer), no effects to Sierra Nevada Yellow-legged frog are expected to occur from herbicide use; other effects, such as habitat modification, are analyzed in this document.

CURRENT MANAGEMENT DIRECTION

Forest Service Manual (FSM) 2670.32 directs that a biological evaluation (BE) be prepared to evaluate project effects upon threatened, endangered, proposed, and sensitive species to ensure that project decisions do not result in loss of species viability or create a trend towards Federal listing. This biological evaluation (prepared in accordance with FSM 2670.3) analyzes the potential effects of fuel reduction and forest health actions for the proposed Rim Fire Reforestation Project.

The Stanislaus National Forest “Forest Plan Direction” presents the current management direction, based on the original Forest Plan as modified through the Forest Plan appeals and amendment processes (USDA 2010a). For all of the sensitive species analyzed in this document, specific direction for the management of these species is lacking in the Stanislaus National Forest Land and Resource Management Plan (USDA 1991), the previous forest plan direction. The Forest Service sensitive species addressed in this

document will be managed under the blanket direction afforded to all sensitive species: they will be managed to ensure conservation or enhancement of their populations and habitats so that the species do not suffer a trend towards Federal listing or a loss of viability (USDA 1991).

The land allocation in the project areas relevant to aquatic species and where the Forest Plan Direction's Standards and Guidelines apply is: Riparian Conservation Area (RCA). The implementation of relevant Best Management Practices (BMP) specific to the activities needed to move the project area towards desired condition and application of Forest Standards and Guidelines related to riparian conservation objectives are consistent with the Forest Plan Direction for the Aquatic Management Strategy (USDA 2010a).

A Forest Goal from the Forest Plan Direction is to "provide habitat for viable populations of all native and desired non-native wildlife, fish and plants" and to "…give special attention to sensitive species to see that they do not become Federally listed as Threatened or Endangered."

The Stanislaus National Forest Aquatic Management Strategy (AMS) identifies endpoints (desired conditions) toward which management moves watershed processes and functions, habitats, attributes, and populations. Goals of the Aquatic Management Strategy include direction to 1) maintain viable populations of native and desired non-native species, 2) maintain habitat connectivity for aquatic and riparian species, and 3) maintain streamflow patterns and sediment regimes in accordance with evolutionary processes.

The AMS has six Riparian Conservation Objectives (RCO):

- RCO 1: Ensure that identified beneficial uses for the water body are adequately protected. Identify the specific beneficial uses for the project area, water quality goals from the Regional Basin Plan, and the manner in which the standards and guidelines will protect the beneficial uses.
- RCO 2: Maintain or restore: (1) the geomorphic and biological characteristics of special aquatic features, including lakes, meadows, bogs, fens, wetlands, vernal pools, springs; (2) streams, including in stream flows; and (3) hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species.
- RCO 3: Ensure a renewable supply of large down logs that: (1) can reach the stream channel and (2) provide suitable habitat within and adjacent to the RCA.
- RCO 4: Ensure that management activities, including fuels reduction actions, within RCAs and CARs enhance or maintain physical and biological characteristics associated with aquatic- and riparian-dependent species.
- RCO 5: Preserve, restore, or enhance special aquatic features, such as meadows, lakes, ponds, bogs, fens, and wetlands, to provide the ecological conditions and processes needed to recover or enhance the viability of species that rely on these areas.

- RCO 6: Identify and implement restoration actions to maintain, restore or enhance water quality and maintain, restore, or enhance habitat for riparian and aquatic species.

Applicable Forest wide Standards and Guidelines include:

- Ensure the habitat needs of sensitive species are considered and that habitat needs of Federally listed Threatened and Endangered species are met.
- Maintain high water quality values.
- In areas adjacent to waters with known populations of western pond turtle, construct new roads or trails or use existing off-road routes for motorized vehicles only if at least ¼ mile from occupied habitat or approved by a wildlife biologist.
- Ensure that management activities do not adversely affect water temperatures necessary for local aquatic- and riparian-dependent species assemblages.
- Limit pesticide applications to cases where project level analysis indicates that pesticide applications are consistent with riparian conservation objectives.
- Within 500 feet of known occupied sites for the California red-legged frog and foothill yellow-legged frog, design pesticide applications to avoid adverse effects to individuals and their habitats.
- Prohibit storage of fuels and other toxic materials within RCAs and CARs.
- Ensure that culverts or other stream crossings do not create barriers to upstream or downstream passage for aquatic-dependent species.
- Prevent disturbance to streambanks and natural lake and pond shorelines caused by resource activities from exceeding 20 percent of stream reach or 20 percent of natural lake and pond shorelines.
- Determine if the level of coarse large woody debris (CWD) is within the range of natural variability in terms of frequency and distribution and is sufficient to sustain stream channel physical complexity and stability. Ensure proposed management activities move conditions toward the range of natural variability.
- Use screening devices for water drafting pumps.
- Post-wildfire management activities in RCAs and CARs should emphasize enhancing native vegetation cover, stabilizing channels by non-structural means, minimizing adverse effects from the existing road network, and carrying out activities identified in landscape analyses. Post-wildfire operations shall minimize the exposure of bare soil.

DESCRIPTION OF ALTERNATIVES

The action alternatives (Alternatives 1, 3, 4and 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. The alternatives contain a mix of one or more of the following activities: site preparation, planting, prescribed fire, mechanical and/or chemical release, noxious

weed eradication (mechanical and/or chemical), and plantation thinning. Summaries of the alternatives are listed below; more comprehensive descriptions of the alternatives are located in Chapter 2 of the EIS.

Table 1 - Comparison of Alternatives

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	21,279	0	21,279	2,867	25,331
Thin existing plantations	12,756	0	12,756	12,756	12,756
Prescribed fire only	0	0	0	34,344	0

Table 2 - Comparison of alternatives: Reforestation Treatments outside of 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.

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 (Chapter 1.04). 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 through conifer planting on 646 acres within the 3,833 deer acres. An additional 33 acres will be monitored for Natural Regeneration within the Deer Enhancement habitat. Table 2.02-1 shows the proposed treatment activities within these units.

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.

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 Enhancement areas) on up to 12,769 acres. Deer 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 the Management Requirements Common to All Action Alternatives (Chapter 2.03).

AQUATIC SPECIES

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.
g. Restrict herbicide type in both upland and near-aquatic suitable habitat for California red-legged frog. Permitted herbicides in upland habitat include aminopyralid and glyphosate (aquatic formulation) only. Do not apply any herbicide within 107 feet of suitable aquatic habitat unless necessary for the treatment of state-listed invasive weeds and approved by the USFWS, in which case a minimum 15-foot buffer would be required, and herbicide type would be restricted to those approved by USFWS.

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.

Under this alternative aquatic habitat would not be affected. Noxious weeds would likely expand in many areas, including adjacent to aquatic habitat. Shrubs would likely dominate the vegetation community in areas where they have become established post-fire, as trees (conifers and hardwoods) would be more repressed as compared to the action alternatives.

Alternative 3

Alternative 3 responds to the significant issues and concerns identified through public scoping. Compared to Alternative 1, it addresses those issues by proposing: additional human and native species health protections (no herbicides) and a different fuel break 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. Chapter 2.01 of the EIS provides more details about each treatment. Appendix E (Treatments) of the EIS 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 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. Because of the higher expected mortality levels, space individual trees 10 to 14 feet apart and space trees in clumps 6 to 8 feet apart within all units to help ensure over 200 trees per acre survive after 5 years. Plant clumps in between the individuals resulting in about 7-foot spacing. 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.

Strategic Fire Management Areas: In Alternative 3, within reforestation units, the identified Strategic Fire Management Feature fuel breaks 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 fuel breaks, 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 fuel break 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 fuel break, 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 fuel breaks are the same as Alternative 1 outside of SFMAs. Emergency Travel Routes are the same as Alternative 1.

On fuel breaks 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 fuel break on an approximate five year maintenance interval. Remove fire ladders into the developing overstory. Dispose of slash by piling, burning, chipping, masticating or removing.

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 meet desired tree survival levels. Grass and sprouting species, such as bear clover, 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 later 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 no additional management requirements for aquatic biological resources; see Management Requirements Common to All Action Alternatives (EIS Chapter 2.03).

Alternative 4

Alternative 4 responds to the significant issues and concerns identified through public scoping. 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 (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. Chapter 2.01 of the EIS provides more details about each treatment. Appendix E (Treatments) of the EIS 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. The heading “Plant Conifers” describes how natural regeneration is treated in Alternative 4.

Noxious Weed Eradication

Alternative 4 includes similar noxious weed eradication as Alternative 3 on 3,131 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.

Plant 200 feet away from known sensitive plant populations. Do not plant within the designated fuel breaks (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.

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 12,768 acres in existing plantations as Alternative 1.

Management Requirements

Alternative 4 includes no additional management requirements for aquatic biological resources; see Management Requirements Common to All Action Alternatives (EIS Chapter 2.03).

Alternative 5

Alternative 5 responds to the significant issues and concerns identified through public scoping. 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. 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 Strategic Fire Management Areas (SFMA). 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 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, 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.

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 fuel break 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 no additional management requirements for aquatic biological resources; see Management Requirements Common to All Action Alternatives (EIS Chapter 2.03).

PROJECT MANAGEMENT REQUIREMENTS FOR AQUATIC SPECIES

Numerous “standard” management requirements and BMPs that may benefit the aquatic environment are described in Chapter 2 of the EIS. The following additional requirements were developed for the project alternatives and are an important part of analysis assumptions and estimates of effects risk and magnitude:

1. 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.

2. 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.

3. 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.

g. Restrict herbicide type in both upland and near-aquatic suitable habitat for California red-legged frog. Permitted herbicides in upland habitat include aminopyralid and glyphosate (aquatic formulation) only. Do not apply any herbicide within 107 feet of suitable aquatic habitat unless necessary for the treatment of state-listed invasive weeds and approved by the USFWS, in which case a minimum 15-foot buffer would be required, and herbicide type would be restricted to those approved by USFWS.

EXISTING ENVIRONMENT

In the sections titled "Species Account" below, occurrence records are based on the Stanislaus National Forest Aquatic Survey Database (AquaSurv, USDA 2010b), California Natural Diversity Database (CNDDB), and University of California, Berkeley, Museum of Vertebrate Zoology database (UCMVZ). When an occurrence record is followed by a date enclosed within parentheses, the date reflects the survey/observation or collection date. Under the "Habitat Account" sections, the habitats associated with the species summarize the information contained in Lannoo (2005) which compiles most of the available and relevant literature into a single account. Additional literature is referenced, as appropriate.

The project area primarily encompasses several major large rivers, multiple primary tributary streams to these rivers, and numerous very small tributary streams to either the large rivers or their primary tributaries. The two main rivers are the Tuolumne River and its largest tributary, the Clavey River. The primary tributaries to the Tuolumne River include Cherry Creek and the North, Middle Tuolumne and South Fork Tuolumne Rivers. Secondary tributaries to the Tuolumne River include Corral Creek, Granite Creek, Grapevine Creek, and Jawbone Creek. Primary tributaries to the Clavey River include the following creeks (proceeding upstream from the Tuolumne): Bull Meadow, Quilty, Bear Springs, Cottonwood, Reed, Reynolds, Bourland, Hull, and Twomile.

While the USGS maps indicate portions of the other streams are perennial, field observations made during surveys indicate these streams are largely intermittent by the middle of summer and into early fall in a typical year. Water in the larger pools may be persistent in most water years and could be considered perennial aquatic habitats. The USGS mapping designation of perennial and intermittent streams was used to determine the amount of aquatic habitat present within the project area.

SPECIES CONSIDERED FOR ANALYSIS:
Table 2 lists the Forest Service Sensitive Species that potentially occur in or could be affected by the project. Table 2 is applied to this analysis document to aid in determining which species are to be considered for analysis based on geographic and elevation distribution and presence of suitable habitat within the project area or within a reasonable distance as to be affected by the implementation of the project.

Species considered for analysis:
If the project area is within the geographic range **but** not within the elevation range of a species, it is not considered further in this document. These species include: limestone salamander and Yosemite toad.

The following species are addressed further in this document for the Rim Reforestation Project: California red-legged frog, Sierra Nevada yellow-legged frog, foothill yellow-legged frog, western pond turtle, and hardhead.

The discussion sections that follow are divided into two categories: Threatened and Endangered species and Forest Service Sensitive species. The Forest Service Sensitive species include the foothill yellow-legged frog, western pond turtle, and hardhead. A Biological Assessment (BA) for the selected alternative will be completed for consultation with the U. S. Fish and Wildlife Service, and includes two federally listed species, the California red-legged frog and Sierra Nevada yellow-legged frog. The analysis for these two species was carried over to the BE to include analysis of effects for all action alternatives and cumulative effects analysis to include private, state, and federal actions.

Table 3 - Stanislaus National Forest Sensitive Species and federally-listed species potentially occurring within or near the Rim Reforestation Project area. Those species selected for analysis are indicated by shading within the table cells

Species	Within Local Range[1], Geographic or Elevation? Y/N	Nearest Documented Occurrence[A]	General and/or specific life stage habitat requirements[B]	Is Suitable Habitat[2] present within:		Citations supporting range, occurrence, and suitable habitat determinations
				Project Area?	One mile?	
SENSITIVE SPECIES						
Limestone salamander (*Hydromantes brunus*) Status: Forest Service Sensitive	G = N E = Y, occurs <3,000'	>7 miles southwest @ Gentry Gulch; >10 miles south @ Merced River ACEC.	General: 7, 9	N	N	[1,2,B]Zeiner et al. 1988, Lannoo 2005, Gorman 1954 [A] CAS, CNDDB, MVZ, Pappenfuss (pers. comm.)
Yosemite toad (*Bufo (Anaxyrus) canorus*) Status: Forest Service Sensitive, Federally Threatened	G = Y E = N, >7,000' locally	>10 miles @ Aspen Valley (Yosemite NP 1933), Upper Relief Valley near Granite Dome (2005)	Breeding: 1c, 2, 6 Adult: 11	N	N	[1,2,B]Lannoo 2005, Zeiner et al. 1988 [A]AquaSurv, CAS, CNDDB, MVZ
California red-legged frog (*Rana draytonii*) Status: Federally Threatened	G = Y E = Y, <4,000'	Within project area is a historic collection at Birch Lake (Mather) and outside area at Jordan Pond	Breeding: 1ab, 2, 4 General: 1abc, 2, 4, 10 Estivation: 11	Y	Y	[1,2,B]Federal Register (Vol. 70, No. 212; Vol. 71, No. 71) [A]CNDDB, MVZ
Foothill yellow-legged frog (*Rana boylii*) Status: Forest Service Sensitive	G = Y E = Y, <4,000' locally	Within project area at multiple locations	Breeding: 1ab, 3 General: 1ab, 10	Y	Y	[1,2,B]USDA 2001, Lannoo 2005 [A]AqauSurv, CNDDB, MVZ
Sierra Nevada yellow-legged frog (*Rana sierrae*) Status: Forest Service Sensitive Federally Endangered	G = Y E = N, >5,000' locally	>3 miles (northeast) @ Bourland Cr.	Breeding: 1bc, 2 General: 1bc, 2	N Y	N Y	[1,2,B]USDA 2001, Lannoo 2005 [A]AquaSurv, CAS, CNDDB, MVZ
Hardhead (*Mylopharodon conocephalus*) Status: Forest Service Sensitive	G = Y E = N, <1,500' in San Joaquin	>10 miles @ Merced River at Snelling; SFkMerced/Merced confluence (1933); >10 miles, M. Fk. Stanislaus R. @ Camp 9	General: 1ab	N	N	[1,2,B]Moyle 2002, [A]USGS, [A]CAS, CNDDB
Western pond turtle (*Emys marmorata*) Status: Forest Service Sensitive	G = Y E = Y	Within project area at multiple locations	Nesting: 8, 11 General: 1ab, 2, 4 Estivation: 10, 11	Y	Y	[1,2,B]USDA 2001, Holland 1994 [A]AquaSurv, CNDDB

[A] Sources: AquaSurv – Stanislaus National Forest Aquatic Survey Database; CAS – California Academy of Sciences; CNDDB – California Natural Diversity DataBase; MVZ – University of California, Berkeley, Museum of Vertebrate Zoology records; USGS - (http://ca.water.usgs.gov/sanj/.html)

[B]Habitats: 1 – Perennial stream or water (a – large stream, >4th order; b – medium stream, 2nd – 4th order; c - small/headwater stream, 1st order); 2 – Permanent/Semi-permanent Pond; 3 – Slow, shallow water with cobble/boulder substrate; 4 – Nearly still pools with emergent vegetation and/or undercut banks; 5 - Waterfall spray zone and/or massive rock areas/granitic talus with flowing water; 6 – Wet meadow; 7 - Talus; 8 – South to west facing low-angle slope with compact, well-drained soils; 9 – Foothill chapparal, chamise, toyon, buckeye; 10 – Dense or well developed riparian vegetation, herbaceous and woody; 11 – Upland area surrounding aquatic/breeding features

Federally listed Threatened and Endangered Species

California red-legged frog

Species Account

California red-legged frog was designated a threatened species on June 24, 1996 (Federal Register 1996). The Recovery plan identified the Tuolumne River as a core recovery area within the Sierra Nevada Foothills and Central Valley recovery unit (USFWS 2002). The frog inhabits 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), and coincides with what will be referred to as the wet-season throughout this document. Females lay from 2,000-6,000 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). Stream temperatures in an occupied creek ranged from 30 to 73 degrees Fahrenheit, with cold water temperatures suspected of delaying tadpole development and metamorphosis (Bobzein and Didonato 2007). Observation sin some areas indicate red-legged frog are absent when water temperatures exceed 70 degrees Fahrenheit (USFWS 2002). Adult movements to terrestrial habitat or between aquatic habitats typically commence with the first fall rain (>0.5 cm) and continue until April (Fellers and Kleeman 2007, Tatarian 2008). Adults may also disperse when aquatic habitats dry out (Fellers and Kleeman 2007, Tatarian 2008). 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 California red-legged frog (CRLF) historically occurred from Riverside County to Mendocino County along the Coast Range; from as far south as Mariposa County to Butte County in the north in the Sierra Nevada; and in Baja California, Mexico (Federal Register 2010). However, the CRLF is now likely extirpated from 70 percent of its former range including the southern Transverse and Peninsular ranges and most localities in the Sierra Nevada, northern coast, and northern Transverse Ranges (USFWS 2002). Range wide, the CRLF was documented to occur at elevations from sea level to 5,200 feet, although the highest known extant population occurs at 3,346 ft. in Placer County (Barry and Fellers 2013) The Fish and Wildlife Service has acknowledged that occurrences above 4,000 feet in the Sierra Nevada are atypical (Federal Register 2006).

The CRLF has not been detected on the Stanislaus National Forest since 1967 and is considered extirpated from the Tuolumne River watershed (USFWS 2002). Historical records of CRLF in and near the vicinity of the project area (California Natural Diversity Database (CNDDB), USFWS 2002, Barry and Fellers 2013) are listed in Table CRLF1. The Stanislaus National Forest has completed extensive herpetofauna visual encounter surveys (Fellers and Freel 1995) across the forest since 1993. However, surveys specific to this project were not conducted and only portions of the project area have been previously surveyed. Appendix B summarizes past surveys and results, indicating

potential red-legged frog habitat surveyed in the project area with no detections. In addition, from 1991 to 2012 Barry and Fellers (2013) conducted day- and night-time surveys in historical red-legged frog Sierra Nevada localities and nearby suitable habitat. Their surveys included all the historical record localities from Table CRLF1 except Upper Lake in Yosemite National Park because they could not find the locality. No red-legged frogs were found.

Table 4. Historical CRLF records from the Tuolumne and Merced River Basins

Locality	**Year (#)**	**elevation**	**basin**
Birch Lake (near Camp Mather)	1922 (1), 1945 (10)	4528’	Tuolumne River
Swamp Lake (Yosemite National Park)	1938 (1), 1939 (1), 1940 (2), 1941 (1)	5020’	Tuolumne River
Miguel Meadow (Yosemite NP)	1939 (2)	5020’	Tuolumne River
Gravel Pit Lake (Yosemite NP)	1940 (1)	5040’	Tuolumne River
Upper Lake (Yosemite NP)	1941 (?)	unk	Tuolumne River
Woods Creek (edge of Sonora)	1950 (4)	1870’	Tuolumne River
Parrot’s Ferry	1975 (1)	2103’	Tuolumne River
Jordan Creek	1967 (1)	2687’	Merced River
Piney Creek	1972 (?), 1974 (?)	1214’	Merced River

Habitat Account

California red-legged frogs use a variety of areas where they are found, including aquatic, riparian and upland habitat (USFWS 2002). Breeding habitat is found in both still water (ponds, marshes, deep pools) and moving water (streams). Hayes and Jennings (1988) describe breeding habitat as deep (greater than 0.7 meters or 2 feet) still or slow moving water with dense, shrubby riparian or emergent vegetation. More recent literature (Bobzien and Didonato 2007, Federal Register 2010) has described breeding habitat as low-gradient, fresh water bodies that hold water for a minimum of 20 weeks during the breeding season. Breeding California red-legged frogs are currently found in both stream and pond habitats. Frogs also utilize non-breeding aquatic and riparian habitats, areas that do not provide suitable breeding habitat but that maintain water past the breeding season or are moist year-round. These areas provide protection from predators and a food source to the frog. Upland habitat surrounds the aquatic habitat and also provides shelter and food. California red-legged frog have been located in upland habitat for extended periods (Tatarian 2008, Bobzien and DiDonato 2007) where they are found in areas that provide moist conditions (under leaf litter, in mammal burrows). California red-legged frogs

disperse over upland or riparian habitat that is free of barriers. Dispersal generally occurs between patches of aquatic habitat within 1 mile of one another (USFWS 2002).

For the purpose of this analysis, potential habitat was identified from existing survey data, GIS maps, and aerial imagery. All perennial and intermittent aquatic habitats within 1 mile of proposed project activities at elevations of 4,000 feet or less (except at historic localities above this elevation) were assessed for CRLF breeding and non-breeding suitability. Potentially suitable stream breeding habitat included streams with the following characteristics: 1) low gradient (<4%), 2) presence of pools holding water for 20 weeks during timing of egg and tadpole development, 3) absence of high stream flow during the breeding period which could wash egg masses or tadpoles downstream. Potentially suitable breeding ponds were identified as large and deep enough to hold water for 20 weeks during egg and tadpole development. Non-breeding aquatic habitat includes any water bodies within 1 mile of potentially suitable breeding habitat, while upland habitat consists of terrestrial areas within 1 mile of suitable breeding habitat. Dispersal habitat includes any upland, riparian, or aquatic habitat accessible and contiguous between suitable breeding habitats, within 1 mile of each other.

Based on the above definitions, five habitat areas were identified within the Rim Fire Project. This includes Birch and Mud Lakes, Drew Creek, Harden Flat Ponds, Homestead Pond, and Hunter Creek and Ponds. Table 3 displays the habitat found in each specific CRLF habitat area.

Table 5. California red-legged frog habitat by area

Habitat Area	Upland Habitat				Breeding pond Acres	Breeding Stream Miles	Non-breeding Stream Miles
	Total Acres	Stanislaus NF Acres	Other Federal Acres	Private Acres			
Birch and Mud Lakes	2897.7	2408.5	117.7	371.5	8.3	0	7.4
Drew Creek	3604.1	3360.0	0	244.0	0	1.3	10.3
Harden Flat Ponds	1526.2	845.1	0	681.1	1.0	0	6.4
Homestead Ponds	2048.9	2046.2	0	2.6	0.2	0	4.8
Hunter Creek and Ponds	11516.0	8395.2	954.6	2166.3	1.6	8.4	26.8

The Rim Fire severely altered the landscape of the Tuolumne River basin and in turn, the potential California red-legged frog habitat. The direct effects of the fire include:

- loss of upland and riparian vegetation which can result in:
  - a loss of cover and moist litter for California red-legged frogs in upland, riparian and dispersal habitat
  - an increase in water temperature, and
- loss of soil infiltration capacity, which coupled with a loss a vegetation can result in:
  - increased water yield and higher flows, and

- increased erosion resulting in increased sediment entering the stream.

The post-fire conditions of each of the habitat areas are discussed below. Substantial vegetation recovery has occurred in the two years post-fire in many areas, primarily shrubs and grasses.

Birch and Mud Lakes are considered potential pond breeding habitat within the Rim Fire Recover Project. Birch Lake is located at Camp Mather, a private property owned by San Francisco Recreation and Parks. Mud Lake is on Forest Service lands approximately 0.5 miles west of Birch Lake. These lakes are located at approximately 4500 feet elevation, at an elevation considered atypical habitat by USFWS (Federal Register 2010). However, this area is one of the historic localities for the species in the Sierra Nevada (Federal Register 2010, Barry and Fellers 2013). The lakes occur on relatively flat ground near the watershed divide. Both lakes support healthy bullfrog (*Rana catesbeiana*) populations.

As shown in Table 4, the upland habitat around Birch and Mud Lakes experienced moderate to high vegetation burn severity (greater than 60 percent), but unburned to low soil burn severity. Loss of vegetation in the upland habitats translates to a loss of cover on more than 60 percent of the area and a reduction in suitability for California red-legged frog. The area immediately adjacent to Birch Lake was unburned or burned at low severity. The area around Mud Lake burned at moderate to high severity. The dispersal habitat between the two lakes had very low burn severity, and therefore no changes to its suitability.

These lakes are located within the Lower Middle Fork Tuolumne River watershed. Erosion modeling using the Disturbed Water Erosion Prediction Program indicated that in the Lower Middle Fork Tuolumne Watershed erosion could increase from background levels of 0.1 to 0.5 tons per acre, to 2.9 tons per acre post fire. Any increased erosion due to the fire is unlikely to have added sediment to Birch and Mud Lakes due to their position high in the watershed. The reduction of vegetation around Mud Lake allows increased solar radiation and a corresponding increase in water temperature. Increased sunlight to the lake and increased temperatures can result in additional riparian and emergent vegetation at Mud Lake.

The non-breeding habitat in this area consists of 7.4 miles of perennial (Tuolumne River, Middle Fork Tuolumne River, and unnamed tributaries) and unnamed intermittent streams (Table 3). The non-breeding stream habitat is located within the Lower Middle Fork Tuolumne River, Tuolumne River – Poopenaut Valley, and Upper Middle Fork Tuolumne River watersheds. Predicted erosion rates for the Tuolumne River – Poopenaut Valley watershed and Upper Middle Fork Tuolumne River watershed are 1.4 and 0.9 tons per acre, respectively. Although sediment delivery into the non-breeding streams is expected, the exact amount is determined by several factors, including soil type, soil texture, hillslope steepness, ground cover quantity, and rainfall intensity. Since the Rim fire California has experienced a severe drought and rainfall in the area of the Rim Fire has been limited. Nonetheless, an increase in sediment is expected. 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 Tuolumne and Middle Fork Tuolumne Rivers, 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. Increased sedimentation can reduce macroinvertebrate production in the stream and result in a reduction in food for the frog. Monitoring of stream sedimentation after the Stanislaus Complex Fire of 1987 in this same basin indicated that sedimentation returned to pre-fire levels within one to five years.

Table 6. Acres of California red-legged frog upland habitat by burn severity

Habitat Area	**Soil Burn Severity**	**Vegetation Burn Severity**
Birch and Mud Lakes		
high	1.7 %	48.2 %
moderate	36.8 %	13.1 %
low	36.7 %	13.2 %
unburned/very low	24.8 %	25.5 %
Drew Creek		
high	4.0 %	68.4 %
moderate	59.7 %	10.3 %
low	26.4 %	9.5 %
unburned/very low	9.9 %	11.8 %
Harden Flat Ponds		
high	0.8 %	18.6 %
moderate	26.3 %	17.3 %
low	57.1 %	27.7 %
unburned/very low	15.8 %	36.3 %
Homestead Pond		
high	1.9 %	45.7 %
moderate	40.5 %	14.0 %
low	24.0 %	10.8 %
unburned/very low	33.6 %	29.5 %
Hunter Creek and Ponds		
high	0.3 %	17.3 %
moderate	18.5 %	12.0 %
low	30.5 %	16.1 %
unburned/very low	50.7 %	54.5 %

The **Drew Creek** habitat area includes 1.3 miles of breeding stream habitat (Drew Creek). Drew Creek was surveyed in 2007 following procedures described in the Stanislaus National Forest Streamscape Inventory (SSI) Technical Guide (USDA 2008a). Drew Creek is a small intermittent stream with average wetted width of 4.2 feet with pools averaging 1.8 feet in depth. Most of the pools had undercut banks and emergent

vegetation. At the time of the survey Drew Creek had little riparian canopy cover as a result of the 2005 Tuolumne fire. Drew Creek flows through a relatively flat valley bottom in this area and has a low gradient. Bullfrogs are not known to be present in Drew Creek. This area is moderately suitable for California red-legged frogs.

As shown in Table 4, the upland habitat in the Drew Creek habitat area experienced moderate to high vegetation burn severity (80 percent) and moderate to high soil burn severity (greater than 60 percent). The riparian corridor adjacent to the stream was unburned or burned at very low severity. Loss of vegetation in the upland areas lessened suitability for red-legged frog.

Drew Creek is located within the Tuolumne River - Jawbone Creek watershed. Erosion modeling using the Disturbed Water Erosion Prediction Program indicated that erosion could increase to 3.6 tons per acre post fire. This watershed has the highest predicted increase in erosion due to the severity of both soil and vegetation burned. It is likely there will be increased sediment in Drew Creek, however because the riparian area is intact some sediment will be filtered out before reaching the stream. In addition, after the Tuolumne Fire very high sedimentation occurred in Drew Creek. Surveys the year following the fire showed that much of the sediment that entered the stream was transported downstream. It is expected that any increased sediment will again be flushed out in one or two years, particularly with the increase in flows due to reduced soil infiltration and vegetation uptake of water. Water temperature is not expected to increase because existing riparian vegetation is largely unchanged by the Rim Fire. Dispersal habitat in this area would occur in an upstream-downstream context along Drew Creek between suitable breeding pools (Bobzien and Didonato 2007, Tatarian 2008), as no other breeding habitat occurs within 1 mile.

The non-breeding habitat in this area consists of 10.3 miles of perennial (Tuolumne River, Middle Fork Tuolumne River, and South Fork Tuolumne River) and intermittent streams (unnamed tributaries) (Table 3). The non-breeding stream habitat is primarily located within the Tuolumne River – Jawbone Creek watershed; however some non-breeding habitat exists within the Lower Middle Fork Tuolumne River and Lower South Fork Tuolumne River watersheds. Predicted erosion rates for these watersheds are 2.9 and 3.1 tons per acre, respectively. An increase in sediment is expected. As described above, sediment input into the Tuolumne River, Middle Fork Tuolumne River and South Fork Tuolumne River is expected to move through the system and return to pre-fire levels in 1 to 5 years.

There are two small **ponds at Harden Flat** that are considered potential pond breeding habitat within the Rim Fire Recover Project. They are located at a privately owned campground and RV park. The ponds occur on relatively flat ground near the Tuolumne River. Bullfrogs are present in the ponds. The upland area to the south of State Highway 120 and the urbanized 20 acres north of the breeding ponds are considered unsuitable for red-legged frogs. The ponds have low suitability.

As shown in Table 4, the upland habitat around Harden Flat Ponds experienced unburned to low soil and vegetation burn severity (greater than 60 percent). Loss of vegetation in the upland habitats translates to a loss of cover on 35 percent of the area. This is a slight reduction in suitability for California red-legged frog. Suppression efforts surrounding the private property were successful and vegetation immediately adjacent to the ponds is largely unburned, therefore no changes to dispersal habitat suitability or temperature of the ponds are anticipated.

These ponds are located within the Lower South Fork Tuolumne River watershed. Erosion modeling using the Disturbed Water Erosion Prediction Program indicated that in this watershed erosion could increase from background levels to 3.1 tons per acre post fire. The unburned vegetation surrounding the ponds would filter much of the sediment before reaching the ponds, although slight increases may occur. A slight increase in sediment can improve habitat for California red-legged frog tadpoles (Bobzien and Didonato 2007).

The non-breeding habitat in this area consists of 6.4 miles of perennial (South Fork Tuolumne River, Big Creek, and unnamed tributaries) and unnamed intermittent streams (Table 3). The majority of the non-breeding stream habitat is located within the Lower South Fork Tuolumne River, with a small amount occurring in the Lower Middle Fork Tuolumne. Sediment delivery into the non-breeding streams is expected; however, it is not expected to remain in the perennial non-breeding habitat in large amounts and is expected to return to pre-fire levels in one to five years. Increased sedimentation of the non-breeding streams can reduce macroinvertebrate production in the stream and result in a reduction in food for post-metamorphic frogs. There is also a predicted increase in discharge for the South Fork Tuolumne River (Flores et al. 2013, Stewart et al. 2013) that can affect suitability for frogs and macroinvertebrates.

Homestead Pond is a small, spring-fed pond located on National Forest lands within the Rim Fire. The pond is located at 3,100 feet in elevation. The pond occurs on relatively flat ground near the top of the Tuolumne River – Grapevine Creek watershed. The pond currently supports a large bullfrog population. Riparian vegetation surrounding the pond consists of sedges and the habitat suitability is considered low based on the lack of other nearby aquatic habitats and the presence of bullfrogs.

As shown in Table 4, the upland habitat around Homestead Pond experienced moderate to high vegetation burn severity (greater than 60 percent), but unburned to low soil burn severity. There is no dispersal habitat associated with Homestead Pond.

The pond is located within the Tuolumne River – Grapevine Creek watershed. Erosion modeling using the Disturbed Water Erosion Prediction Program indicated that erosion could increase 2.0 tons per acre from background post fire. The vegetation between the spring that feeds it and the pond is unburned. Because of this unburned vegetation and the pond's location in the watershed, sediment increases to the pond are unlikely.

The non-breeding habitat in this area consists of the perennial Tuolumne River and unnamed intermittent streams (4.8 miles, Table CRLF2. The non-breeding stream habitat is located primarily within the Tuolumne River – Grapevine Creek watershed, with a small amount of non-breeding habitat located in the adjacent Upper North Fork Merced River and Big Creek watersheds of the Merced River drainage. The Rim Fire burned a small area of the Upper North Fork Merced River watershed (eight percent), including the headwaters of the non-breeding habitat in this watershed. Erosion was predicted to increase from backgrounds levels of 0.1 to 0.5 tons per acre up to 0.7 tons per acre. The Big Creek watershed was not burned in the Rim Fire. Sediment delivery into the non-breeding streams is expected, although the Tuolumne River is expected to flush the sediment in one to five years and the increased erosion in the North Fork Merced River is only slightly over background levels.

The Hunter Creek habitat area is the largest considered in this analysis for California red-legged frog. Hunter Creek is a small to medium sized perennial stream with a moderate overall gradient (3 – 8%) with approximately 7.5 miles of stream that provide suitable breeding habitat. There are numerous long, deep, slow moving pools with roots from riparian vegetation to permit egg attachment. The stream flow typically diminishes in April and May, bringing discharge to a suitable level during CRLF breeding season. Hunter Creek supports a naturalized population of rainbow trout, but there are no non-native predators (bullfrogs, centrarchid fishes) known from the watershed. In addition to Hunter Creek there are five ponds within the habitat area, all located on private lands that appear to provide suitable breeding habitat. Hunter Creek is considered moderately suitable for California red-legged frog.

As shown in Table 4, the upland habitat in this habitat area was largely unburned to low burn severity for both soil and vegetation burn severity (greater than 80 and 70 percent, respectively). The fire burned the upper elevation of the habitat area at the headwaters of Hunter Creek and the southern portion of the habitat area in the Tuolumne River – Grapevine Creek watershed. Over 47 percent of the habitat area is outside the Rim Fire perimeter. The five ponds all occur within the fire area. The area around Pond 1 (section 18 north of Hunter Creek) was unburned or burned at low soil burn severity with up to 50 percent loss of basal area. The area around Pond 2 (section 17 north of Hunter Creek) in unburned or has low vegetation and soil burn severity. The dispersal habitat between these ponds has unburned or low soil burn severity with a loss of vegetation basal area up to 50 percent while the intermittent channel that connects these ponds to Hunter Creek was mixed in burn severity. The areas around Pond 3 (Section 20 at Round Meadow) remained unburned or burned at low severity for both soil and vegetation, while at Pond 4 soil burn severity was moderate and vegetation lost 50 to 100 percent of the basal area. The area between the ponds at Round Meadow burned at low to moderate soil burn severity with 50 to 100 percent basal area loss. Pond 5 is located on Rogge Ranch and had unburned to low soil burn severity and vegetation loss of 0 to 50 percent of the basal area. There is no dispersal habitat for Pond 5 as it is greater than 1 mile from other breeding habitat.

Hunter Creek and ponds 1 and 2 are within the Lower North Fork Tuolumne River watershed where erosion was predicted to increase to 0.9 tons per acre. Ponds 3, 4 and 5 are located within the Tuolumne River – Grapevine Creek watershed where erosion is predicted to increase to 2.0 tons per acre. Sediment at the headwaters of Hunter Creek is expected to increase slightly, however the sediment is expected to be washed downstream fairly quickly due to the gradient of the stream (three to eight percent) and the increased water flow from tributary input as you move downstream through the breeding habitat. Sediment is likely to increase in ponds 1, 2 and 5. Ponds three and four are located in the upper portion of the watershed and vegetation burned at low to moderate severity, so sediment delivery into the ponds is not expected.

The non-breeding habitat in this area consists of 26.8 miles of perennial streams (Hunter Creek, North Fork Tuolumne River) and intermittent streams (Duckwall Creek, Grapevine Creek, and unnamed tributaries) (Table 3). The non-breeding stream habitat is found within both the Lower North Fork Tuolumne River and Tuolumne River – Grapevine Creek watersheds. Predicted erosion rates are 0.9 and 2.0 tons per acres, respectively. Sediment increases in the non-breeding habitat are expected, however will likely be flushed from the system in one to two years. In non-breeding habitat outside the fire there will be no increase in sediment.

Sierra Nevada yellow-legged frog

Species Account

The SNYLF inhabits high elevation lakes, ponds, marshes, meadows, tarns, and streams. They are highly aquatic at all lifestages and are more commonly associated with deep water habitats (greater than 2 meters or 6.5 feet) that lack introduced fish. While the frog populations show a 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 5 to 8 centimeters (2 to 3 inches) in depth (Mullally and Cunningham 1956, Jennings and Hayes 1994, Federal Register 2013).

At lower elevations within their historical range, the frog is associated with rocky streams and wet meadows surrounded by coniferous forests (Zweifel 1955). Streams utilized by adults vary from high gradients with numerous pools, rapids, and small waterfalls, to streams with low gradients and slow flows, marshy edges, and sod banks (Zweifel 1955). Aquatic substrates vary from bedrock to fine sand, rubble rock fragments, and boulders (Zweifel 1955). The SNYLF is rarely found exclusively in small or ephemeral streams which typically lack sufficient depth and hydroperiods for adequate refuge and overwintering habitat (Jennings and Hayes 1994). However, these small streams at lower elevations locally provide suitable habitat for post-metamorphic life stages, especially when they maintain permanent water.

The timing of breeding varies annually, but occurs shortly after snowmelt and typically between May and July. Females lay clutches varying from 15 to 350 eggs per mass (Vredenburg et al. 2005) attached to rocks, gravel, and vegetation or under banks (Pope 1999). Eggs hatch in about 2.5 to 3 weeks (Pope 1999). Tadpoles 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 high mountain lakes, adult frogs typically move only a few hundred meters (Matthews and Pope 2001, Pope 1999), but single-season distances of up to 3.3 kilometers (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, occasional overland movements by adults of over 66 meters (217 feet) have been recorded (Pope 1999). The farthest reported movement distance from water is 400 meters (1,300 feet) (Federal Register 2013).

The SNYLF has been found throughout the Stanislaus National Forest at elevations between 5,400 feet and 9,700 feet. Survey records from 1993 to 2013 indicate the frog is associated with streams, streams or potholes in meadows, and lakes. SNYLF occurrences on the STF are most commonly found in high elevation (alpine) lake habitats. There are three occurrence records on the forest below 7,000 feet in elevation, Skull Creek (5,400 feet), Moore Creek (6,300 feet), and Snow Canyon Creek (6,550 feet). The Skull Creek occurrence is potentially extirpated based on multiple recent surveys with non-detections, while the Moore and Snow Canyon Creek populations have been recently confirmed as extant. Within the fire perimeter, 221 aquatic visual encounter surveys have been conducted including 99 surveys within the documented elevational range (between 4,500 and 6,500 feet in elevation, Appendix 4, Map 4a). The surveys covered a range of stream sizes from 1st to 4th order and included approximately 70 discrete streams or sections of streams. Most surveys occurred when the frogs would have been active: eighty-nine surveys were conducted between 6 June and 19 September and 10 surveys were conducted after 28 September. No SNYLF (extant or historic) have been found within the Rim Fire Perimeter according to STF or CNDDB records.

There are three current or historically occupied localities in the vicinity (within 5 miles) of the Rim Fire perimeter: Snow Canyon Creek, Bourland Creek, and an unnamed creek in Yosemite National Park. Snow Canyon Creek is a tributary to Cherry Creek immediately upstream of Cherry Lake, located along the northern edge of the fire at an elevation of 6,600 feet, and approximately 1.5 miles northeast of the nearest project treatment units. Portions of the stream were within the fire perimeter, but the known occupied reach was not directly affected by the fire. Bourland Creek is also located along the northern edge of the fire perimeter, and like Snow Canyon Creek, the known occupied portion of the stream was not directly affected by the fire. A small population of frogs has been documented in in creek running through Bourland Meadow at an elevation of approximately 7,000 feet. The occupied site is approximately 3.5 miles north of the nearest project units. An unnamed creek near Laurel Lake in Yosemite National Park (approximately two miles east of Lake Eleanor and three miles north of Hetch Hetchy reservoir) apparently supports a population of SNYLF (CNDDB 2014) at an elevation of 6,480 feet and is approximately 4.5 miles east of the nearest project unit.

Habitat Account

The SNYLF is associated with a variety of aquatic habitats including wet meadows, streams, and lakes (Vredenburg et al. 2005). Highest summer densities and overall total

numbers are found in lakes lacking introduced fish, possessing high numbers of *Hyla regilla* tadpoles, more than 1 meter in depth, and near-shore habitat with warm water temperatures (Matthews and Pope 2001). Deep water habitats (greater than 5.4 feet (1.7 meters)) provide the best opportunity for annual survival of adults and their multi-year tadpoles because complete freezing, very low dissolved oxygen conditions, and regular drying are factors that affect the ability of a water body to support all life stages.

Egg masses are attached to streambed substrates or submergent/emergent vegetation or under banks. Once the embryos develop into tadpoles, the tadpoles utilize shallow, warm water for thermoregulation, foraging, and growth. If disturbed, the tadpoles rapidly retreat from shallow water and hide in deeper water, in mud, under rocks, or in vegetation. As noted earlier, deep water that does not freeze regularly to the bottom of the water body is required to allow the tadpoles to develop to metamorphosis.
During the active season (May through October), post-metamorphic individuals use a variety of habitats ranging from shallow snowmelt pools to streams connecting lakes and ponds to deep water lakes. Matthews and Preisler (2010) indicated site fidelity was high among individuals found in breeding, foraging, and overwintering habitats. Dispersal between these sites is not limited to aquatic routes. Although these frogs are often seen within a meter or two of water they can make terrestrial movements between suitable habitats up to one kilometer. Post-metamorphic individuals have been locally observed basking in full sun or on the water's surface, hiding under streambanks, logs, or in herbaceous riparian vegetation, and lying at the bottom of lakes/ponds in deeper water. Adult and subadult frogs likely avoid freezing in the winter by utilizing underwater crevices in deep waters (Matthews and Pope 2001).

SNYLF home range varies throughout the year and by individual. In August, home range can vary from a little under 20 square meters to over 1,000 square meters. Home ranges are largest in September (53 to 9,807 square meters) which likely accounts for foraging movements. By October, home ranges are very small (3.2 to 82 square meters) as frogs settle into overwintering habitat (Matthews and Pope 2001).

Additional information defining suitable habitat has been provided by the Federal Register (2013) and is briefly summarized here. The three essential habitats required by the frog include suitable aquatic breeding, aquatic non-breeding, and upland habitat. <u>Suitable aquatic breeding habitat</u> includes: 1) permanent water bodies (or those connected or close to permanent waters) that are 2) deep enough to prevent freezing in winter, 3) support a natural flow pattern, 4) be free of fish or other introduced predators, and 5) regularly maintain water persistence to allow for tadpole development. <u>Aquatic non-breeding habitats</u> share many of the characteristics breeding habitats do, but they may lack adequate water depth to allow for completion of the species life cycle. <u>Upland habitats</u> include both immediate riparian areas around aquatic habitats (25 meters from the edge of water) and areas between suitable breeding habitats, and watershed-wide areas that provide the quantity and quality of water needed by the frog.

Two methods were used to identify suitable habitat within the project area and included a desk and/or field review of suitable habitats above 5,000 feet within the fire perimeter

and subsequent application of the species distribution model developed by Roland Knapp. This model used historic and current occurrences to develop a predictive habitat model for the historical probability of occurrence of the SNYLF within the known historical range (Roland Knapp, personal communication). The forest's aquatic survey database was queried for all streams in and adjacent to the fire perimeter. For the waters within the range of the frog, physical habitat survey information was reviewed if available to determine whether pool habitat was deep enough to allow for successful tadpole rearing. Suitable breeding habitat is defined in the Federal Register (2013) as having water depths greater than 5.6 feet. For the Rim Fire Reforestation project, this definition was modified to include water depths greater than 4 feet to account for local conditions applicable to occupied sites in lower elevation streams. The lowest elevation occurrences on the forest (see Species Account) are all associated with deep (greater than 4 feet), low gradient (less than 2 percent) stream sections and most are also associated with meadows (except Moore Creek). Small (1st or 2nd order), steep (average gradient greater than 6 percent), and isolated (did not connect to a logical breeding habitat) headwater streams were discounted as being suitable breeding habitat because field data indicate they do not have sufficient water depth. This method identified potentially suitable habitat within the Rim Fire perimeter.

The second method used included the application of the SNYLF range map developed by Roland Knapp. We overlaid the range map with the fire perimeter and identified the overlapping streams and other aquatic features. These streams are consistent to previous determinations of suitable habitat for the frog and include the upper portion of Reynolds Creek, two ponds on Kibbie Ridge, a short section of Eleanor Creek below Lake Eleanor, and a portion of the Middle Fork Tuolumne River. These four suitable habitats are described below.

<u>Reynolds Creek</u>

Aquatic Breeding, Rearing and Non-breeding Habitat: Reynolds Creek is one of the main tributaries to Reed Creek, a tributary of the Clavey River. The portion of Reynolds Creek within the range of the SNYLF (using the Knapp distribution model) lies almost entirely within an 8th level HUC (hydrologic unit code) and provides approximately 4.3 miles of mapped perennial channel and 1.9 miles of mapped intermittent channel. Approximately 0.9 miles of the perennial channel is 2nd order, with the remainder being 1st order stream. Average gradient in the 2nd order reach is 2.0 percent (range 1.2 to 3.6 percent), but the average gradient in the 1st order tributaries ranges from 8.4 to 24.4 percent. In July 2008, pool measurements, including pool depth, were taken along approximately three miles of the mainstem from an elevation of 5,720 to 6,160 feet. Both of the headwater tributaries were also surveyed during this time (up to an elevation of 6,920 feet). Average pool depth in the 2nd order section was 0.65 feet (range 0.3 to 1.5 meters (1 to 5 feet)). Of the 76 pools measured in the 2nd order section, 14 (18 percent) were over 1.0 meter in depth. The depths and pool frequency indicate the stream could potentially support the SNYLF. In the two headwater tributaries, pool depths were much lower on average (0.5 meters) and did not have any pools greater than one meter in depth. The overall habitat suitability in Reynolds Creek is considered to be very low because the stream supports a self-sustaining trout population where there is low gradient (less than 4

percent), deep water (greater than 1.0 meter) and does not maintain deep, permanent water (average depth 0.3 meters) in the fishless sections.
The fire affected approximately 80 acres of the 1,930 acre 8th level HUC, or 4 percent of the watershed. Fire severity in was generally low with 58 percent in the low burn severity class (less than 25 percent tree mortality), 32 percent in the low-moderate class (25 to 50 percent mortality), 6 percent in the moderate class (50 to 75 percent mortality), and 4 percent in the high mortality class. Post-fire increases in erosion are expected to be very small, if detectable, due to the low amount of fire in the higher vegetation burn severity classes and the high levels of ground cover and tree canopy remaining in the burned portion of the watershed. For the lightly burned areas, the scorched needles were dropped by the trees and very high levels of ground cover (greater than 70 percent) are present to limit erosion. Also, the main patch (12 acres) of higher burn severity is located over 0.5 miles from the creek, and the high levels of ground cover in between the creek and fire area should be effective at minimizing the sediment delivery to the stream associated with surface and rill erosion.

Upland Habitat: There are approximately 85 acres of upland habitat adjacent to the perennial stream sections of Reynolds Creek and an additional 38 acres adjacent to the intermittent streams within the distribution range of the frog. Approximately 12 acres of upland habitat was affected by the fire. All of the 25 meter SNYLF upland area burned in the lowest two severity classes and there was very little loss of riparian shading. There was some loss of ground level cover (logs, herbaceous vegetation, shrubs), but adequate levels remain and habitat suitability was slightly reduced from high to moderate. Approximately 0.4 miles of perennial suitable habitat and 0.2 miles of intermittent channel are within the fire perimeter. As discussed earlier, post-fire increases in sedimentation in all of the Reynolds Creek watershed affected by the fire are expected to be very minor.

Kibbie Ridge Area

This area includes two ponds situated near the top of Kibbie Ridge, Big and Little Kibbie Ponds, and a short section of Eleanor Creek.

Big Kibbie Pond

Aquatic Breeding, Rearing and Non-breeding Habitat: Big Kibbie Pond is approximately 0.7 acre in size and fish-free, providing approximately 0.15 miles (234 meters) of shoreline at an elevation of 5,400 feet. No physical habitat assessments have been completed for Big Kibbie Pond but aquatic amphibian and reptile visual encounter surveys report an average depth of 3.6 feet (43 inches) and the estimated maximum depth is less than 6 feet. There is little to no canopy and ample basking opportunities are present. Submergent aquatic grasses and algae dominate the vegetation on the shallow banks. Half of the water's surface is covered by lilies at times of the year. Big Kibbie Pond provides moderate to high suitability breeding habitat because water is deep enough to maintain aquatic habitat perennially in almost all years and prevent freezing solid. The only limitation to the pond is that water depth can be less than 3 feet by the end of summer even in wetter than average years. If the pond does not fill prior to the onset of winter, then water depth may not be adequate to prevent freezing during cold weather

(the pond likely fills during snowmelt). The hydrology of the pond is apparently influenced by groundwater because there are no defined inlet or outlet streams.

Big Kibbie Pond sits close to the top a ridge and there is a limited potential for measurable increases in post-fire sedimentation because of the lack of a drainage network leading into the pond, and the slopes adjacent to the pond are very low (less than 3 percent) enough to prevent overland transport of sediment to the pond. The habitat suitability will remain unchanged in the post-fire environment. Big Kibbie pond has been surveyed six times since 2004 and SNYLF have not been detected. Four of the surveys (2004) were tied to California red-legged frog surveys where two day visits (June 29 and July 14) and two night visits (July 1 and 14) were made. The pond was also surveyed on June 16, 2008 and April 11, 2014. The other waters near the pond that provide some type of aquatic habitat include Cherry Lake and Lake Eleanor, both of which are unsuitable for supporting a frog population per considerations listed in the Federal Register (2013). Big Kibbie Pond is considered to be unoccupied because multiple surveys have been conducted in the past ten years without a detection of the SNYLF (see Species Account section).

Upland Habitat: Within 25 meters of Big Kibbie Pond there are approximately 3 acres of potential upland habitat. Additionally, there are 2.5 acres of upland habitat between Big and Little Kibbie Ponds because they are within 150 meters of each other. The primary CWHR vegetation types are Sierran Mixed Conifer (41 percent), Montane Chaparral (38 percent), and Perennial Grassland (20 percent). The upland habitat mainly burned at moderate to high severity (94 percent combined) and will have low suitability for at least 5 years due to the low amount of existing ground cover. Some boulders and downed woody debris remain as cover objects.

Little Kibbie Pond

Aquatic Breeding, Rearing and Non-breeding Habitat: Little Kibbie Pond is approximately 0.6 acre in size, fish-free, and located at approximately 5,400 feet. No physical habitat assessments have been completed for Little Kibbie Pond, but amphibian and reptile visual encounter surveys (2004, 2008, 2014) report an average depth of 20 inches (1.7 feet) with very little canopy cover provided by surrounding conifers. The pond was almost dry during the April 2014 survey. Short herbaceous vegetation covers the banks and shallow areas of the pond. Breeding habitat suitability is low due to its shallow depth and complete drying in average and below precipitation years. The pond does provide high quality non-breeding aquatic habitat due to its close proximity to Big Kibbie Pond (approximately 125 meters to the north) and lack of predatory fish. Approximately 73 percent of the vegetation in the Little Kibbie Ponds watershed burned at high severity; however, because the pond sits atop a ridge, there are no defined inlet streams, and the hillslopes adjacent to the pond are low gradient, there is a very low likelihood that the pond will receive any measurable levels of sedimentation from the effects of the Rim Fire. Therefore, the aquatic habitat suitability will remain unaffected by the fire. The survey history for Little Kibbie Pond is the same as that given for Big Kibbie Pond and Little Kibbie Pond is assumed to be unoccupied by the frog.

Upland Habitat: Within 25 meters of Little Kibbie Pond there are approximately 1.5 acres of upland habitat. There are 2.5 additional upland habitat acres connecting Big and Little Kibbie Ponds because they lie within 150 meters of each other. The primary WHR vegetation types are Sierran Mixed Conifer (54 percent) and Montane Chaparral (40 percent). Vegetation in the upland habitat primarily burned at moderate to high severity (85 percent combined) and the habitat will have low suitability for at least 5 years due to the limited amount of cover.

Eleanor Creek

Aquatic Breeding, Rearing and Non-breeding Habitat: There is approximately one mile of Eleanor Creek downstream of Eleanor Dam within the range (using the Knapp distribution model) of the frog and 0.5 miles is on the STF within the fire perimeter. The elevation ranges of these sections of stream are from 4,320 to 4,610 feet and 4,320 to 4,420 feet for the 1.0 and 0.5 mile reaches, respectively. This section of stream on the STF is below the lower elevation range of the species (4,500 feet) listed in the Federal Register (2013), but is within the Knapp distribution range. The creek below the dam provides very low suitability habitat for the SNYLF because the streamflow is regulated by an upstream dam, there is a self-sustaining population of introduced trout, and is at or below the lower elevation range of the frog. As noted in the Federal Register (2013), the presence of dams greatly reduces habitat suitability, potentially rendering them unsuitable, through habitat fragmentation, creation of migration barriers, alteration of hydrology (irregular and unseasonal flows), and maintenance of introduced fish populations. There is a very low likelihood of occupancy based on the factors identified above.

The portion of the Eleanor Creek watershed downstream of the dam and extending to the STF boundary burned at high or very high severity. This suggests that the steeper hillslopes adjacent to the stream are exceptionally vulnerable to post-fire erosional processes and extensive sedimentation of slower water habitats is likely. Deep water should be maintained in the pools of higher gradient (>8 percent) sections of stream and there would be adequate habitat available to individuals.

Upland Habitat: There are approximately ten acres of upland habitat within 25 meters of the section of stream on the STF and 22 acres of upland along the one mile of stream below Eleanor Dam. Greater than 95 percent of the upland area burned at high or very high vegetation severity which suggests most of the upland cover was eliminated by the fire. As such, the upland habitat suitability was greatly reduced and currently provides low to low-moderate suitability habitat for the frog. Some refuge habitat is available in the crevices of rocks along the stream, but very little woody or herbaceous obligate riparian vegetation is present.

Middle Fork Tuolumne River

Aquatic Breeding, Rearing and Non-breeding Habitat: There is approximately 1.1 mile of the Middle Fork Tuolumne River (MFTR) and 0.4 mile of intermittent tributary streams on Forest Service lands that is also within the range (using the Knapp distribution model) of the species. The MFTR covers an elevation range of approximately 4,600 to

4,900 feet, and the tributaries extend to elevations of approximately 5,200 feet on Forest Service lands. The MFTR is a free-flowing tributary to the Tuolumne River and originates in Yosemite National Park (YNP). Breeding habitat suitability in the MFTR is very low due to a self-sustaining population of trout which extends several miles into YNP. Because this section of the MFTR is well below the lowest known populations on the forest, a self-sustaining population of introduced trout has been present for approximately 100 years, and this relatively large river is atypical of SNYLF habitat at lower elevations, it is unlikely that the river on the STF is occupied by SNYLF.

The upper MFTR watershed was extensively affected by the Rim Fire. The Upper MFTR 6th level HUC watershed is approximately 31,354 acres in size. Approximately 54% of the watershed (17,028 acres) was affected by the fire with most of the unburned area located in the upper portion of the watershed. In the portion of the watershed affected by the fire (STF and YNP combined), vegetation burn severity ranged from 5,041 combined acres of very low and low severity (30 percent), 3,228 acres of moderate severity (19 percent), and 8,759 acres of high severity (51 percent). The amount of area affected by high and moderate severity fire is high enough that moderate to high levels of sedimentation should affect the main channel of the MFTR in the next two to five years. While some sedimentation of slow water habitats is expected, the high annual snowmelt flows will be effective at maintaining deep water non-breeding habitat areas suitable for the SNYLF. The anticipated increase in sedimentation would not affect the overall habitat suitability because of the factors identified above or likelihood of occupancy in the next five years.

Upland Habitat: There are approximately 1,508 acres of suitable upland habitat in the Upper MFTR 6th level HUC and 954 acres of suitable upland habitat within the fire perimeter. On STF lands, there are approximately 22 acres of suitable upland habitat adjacent to the MFTR and 8 acres of upland habitat adjacent to the 0.4 mile of intermittent stream. Burn severity within the upland area was variable, but moderate and high severity was most common (>45 percent) within this habitat type. The mosaic of burn severity indicates that some patches of moderate to moderate-high suitability habitat are present along the MFTR and the intermittent tributaries, but habitat suitability was reduced to low to moderate in the higher burn severity areas. As with Eleanor Creek, extensive boulder and bedrock areas adjacent to the stream provide cover within the upland habitat.

Forest Service Sensitive Species

Foothill yellow-legged frog

Species account

The following watersheds affected by the Rim Fire are known to support breeding populations of the foothill yellow-legged frogs: Basin Creek, Bull Creek, Bull Meadow Creek, Drew Creek, Grapevine Creek, Hunter Creek, Moore Creek, Clavey River, North Fork Merced River, North Fork Tuolumne River, and Tuolumne River. Also, the frog (post-metamorphic stages) has been found in several small unnamed tributary streams to the Clavey River and these populations may reflect behavioral dispersal away from

breeding areas in the Clavey River. For the other remaining streams with breeding populations, it is reasonable to assume that dispersal occurs in tributaries close to the breeding areas.

Local observations indicate the frog is typically found at elevations lower than 4,000 feet and most of these observations were of post-metamorphic individuals. The highest known elevation breeding population on the forest is in the North Fork Tuolumne River (3,000 feet) and this is probably the upper elevation extent for breeding for the larger streams on the forest. This is because the developmental period between eggmass and metamorphosis is dependent upon water temperatures and it is unlikely that there is sufficient developmental time above this elevation. The maximum elevation for the species is considered to be 4,200 feet for adults and subadults in tributary streams near breeding sites.

A query of the UCMVZ database listed a 1962 occurrence of the frog at Colfax Springs on private land located two miles east of the project area, and a 1948 occurrence at Harden Flat (private land) on the South Fork Tuolumne River within the project area. The CNDDB also lists the FYLF occurrence at Bull Creek.

Habitat account

Perennial water is needed by the FYLF because it is rarely found far from water. This frog is typically associated with several types of streams based on life history aspects. Adults can occur along the margins of large and small streams for the entire year, sitting under sedges and grasses at streamside, wedged in the cracks of boulders, or perched on wood or rocks near the stream. However, some adults and subadults may disperse from the breeding sites to small tributary streams (Kupferberg 1996) and seem to use similar habitat elements as just noted. Perennial water in these tributary waters typically is provided by perennial streams and intermittent streams with deeper pools or geologic contact zones where water surfaces in the channel. We have observations of adults lying on the bottom of the stream during cold weather apparently avoiding colder air temperatures (and/or wind chill). All post-metamorphic individuals will find basking sites in the sun during part of the day as part of their thermoregulation process.

The frog breeds near cobble bars in large rivers (Kupferberg 1996) like the Clavey River or in slower moving run habitat in close proximity to a pool in smaller streams (ex. Hunter Creek, personal observations). The timing of breeding depends on several factors, some of which are determined by the size of stream in which the breeding occurs. In larger streams originating in snowpack dominated elevations, the frogs wait until the seasonal pulse of high water begins to recede and water temperatures rise to around 60 degrees Fahrenheit. Locally, this timing begins in May, peaks in early to mid-June, and extends into July during colder or high water years. In smaller streams without snowpack dominated flows, breeding seems dependent on day length and water temperature (also approaching 60° F) and may occur as early as April in some streams. In both stream types, the timing of breeding is such that the negative effects of rapidly rising water levels reduce the risk of the eggmasses being scoured away by high flows. Also, the slowly receding water levels allow the developing tadpoles to gradually follow the warm

water habitat found in water along the edges of the stream. The females attach egg masses to the downstream side of larger substrates (cobbles and boulders) and may prepare the surface of the substrate by scraping the surface with the hind legs to improve egg adhesion (Wheeler et al. 2003, Rombough and Hayes 2005). The presence of emergent rocks may be an important factor in providing eggmass attachment sites with low velocity habitats available on the downstream side of the rock (Kupferberg 1996). There is a good indication that there is a high degree of site-fidelity for breeding as indicated by decades of repeated use at the same location (Kupferberg 1996, Lind 2005). Eggs hatch as quickly as 1-2 weeks or as long as 5 weeks, depending on water temperature.

Immediately upon hatching, tadpoles drop from the eggmass and remain relatively close to the mass for the first week or so. As they begin to forage and increase in size, they disperse to a broader area in search of food and to potentially reduce predation risk. Tadpoles require shallow water for foraging on the algae growing on substrates and deeper water with inter-substrate crevices for escape refuge. The tadpoles feed on algae/epiphytic diatoms (attached to other plants or algae) growing on rocky substrates, vegetation, or on masses growing in pools in intermittent streams. We have observed tadpoles in an advanced stage (with hind legs) remaining motionless in shallow water and can only guess that this strategy minimizes physical exertion while the tail is being resorbed and metamorphosis becomes complete. Tadpoles metamorphose locally in early fall and can usually be detected at breeding sites in September and October. Little is known about the dispersal of recently metamorphosed individuals (yearlings) from breeding habitat. They could migrate upstream or into the surrounding upland in close proximity to the stream's edge. Juveniles or subadults can be found in a variety of habitats from open cobble bars along streams that support breeding to small tributary streams inhabited by dispersing adults. Their habitat requirements seem to parallel those of adults.

For all life stages, two habitat elements seem to be of particular importance: deep water in pools (>1-2 feet) and sediment free spaces between stream substrates (rocks). For post-metamorphic individuals in non-breeding habitats, individuals tend to be found more regularly adjacent to deeper water habitats. This deep water is a refuge when a frog is evading an actual or perceived predation event. The frogs jump from the water's edge and swim to the bottom, frequently burying themselves in silty substrates or hiding in the spaces under rocks. Tadpoles similarly use the spaces under rocks when frightened as a refuge habitat.

Other habitat elements that have some bearing on habitat suitability include dense herbaceous vegetation growth on the streambanks (sedges and grasses), stream shading from woody riparian vegetation, larger substrates for attaching egg masses, and predictable streamflow. The vegetation serves as overhead cover, potentially reduces predation risk, and may provide terrestrial food sources for post-metamorphic individuals. Substrates for egg attachment are hard to define because they are typically located in relatively shallow water and there must be a water velocity cue (near zero velocity) that the adults use in choosing a breeding site (Lind 2005). This choice likely

allows the tadpoles to drop out of the eggmass in areas with food resources and without being washed downstream. Predictable streamflow is related to a gradual recession of seasonal high flow, and, while peaks of increased streamflow may occur, modest changes in flow can occur daily with very gradual increases and decreases. These daily fluctuations are important because if they occur too quickly, they could result in tadpoles being washed downstream (increased flow) or stranding in shallow water habitats (decreased flow).

Habitat suitability models have not been constructed for all life stages of the FYLF, but habitat suitability criteria have been developed for eggmass and tadpole life stages (Yarnell et al. 2011). However, these criteria were developed for large rivers like the Clavey and were intended to be used to quantify suitable breeding habitat using available modeling techniques. We did consider the criteria needed for breeding and tadpole rearing in assessing the existing environment and addressing the affected environment, but did not strictly apply them because we know that the Clavey River supports breeding in the lower reaches of the river and the criteria developed by Yarnell, et al. (2011) do not address habitats needed by other life stages.

Suitable aquatic habitat was identified as all intermittent and perennial streams lower than 4,200 feet in elevation. This elevation limit applies to adults and subadults dispersing away from breeding habitats. The elevation limit for breeding habitat used is 4,000 feet in small streams (watershed area <2,500 acres) and 3,500 feet for larger rivers and streams. These limits were derived from the existing information we have in our survey database. Since the frogs are primarily known to use a narrow riparian area along the stream, an upland habitat area extending 30 feet from both edges of the stream was used. Table 3 shows the amount of suitable habitat in key streams within the project area.

The following sections describe what is known about the post-fire condition of the streams supporting breeding populations of the FYLF and streams providing suitable habitat for the frog. Burn severity mapping done post-fire was primarily used to identify near stream and watershed level impacts to upland vegetation. As will be discussed later in the document, the extent of high severity fire has the greatest potential to impact important habitat elements, whereas, moderate and low severity fire have less potential to impact those elements. The description of streams occupied by the FYLF and providing suitable habitat for the frog are categorized by the primary watershed they drain into. This section is broken down into the Tuolumne River, North Fork Tuolumne River, Clavey River, and North Fork Merced River. Tributaries specific to each of these watersheds are grouped again at these four levels. So, small, direct tributaries to the Tuolumne (examples, Grapevine Creek, Drew Creek) are included in the Tuolumne River heading and described following the description of the Tuolumne River.

Tuolumne River

The Tuolumne River is the main watershed the Rim Fire affected. The Tuolumne is the largest tributary to the San Joaquin River and its headwaters are in Yosemite National Park. Above Don Pedro Reservoir, the Tuolumne has a watershed area of approximately

819,000 acres and there are over 30 miles of mainstem river on the Stanislaus National Forest between the Yosemite National Park boundary and the high water mark at Don Pedro reservoir. There is an additional 6.5 miles between the forest boundary and the base of O'Shaughnessy Dam. The geomorphology of the Tuolumne is controlled by bedrock as described for the Clavey.

The runoff in the river is primarily attributable to snowpack, but the hydrology of Tuolumne is altered by dams on the Tuolumne (O'Shaughnessy Dam) and Cherry Creek. Stream flow in the Tuolumne between O'Shaughnessy dam and Early Intake is determined by negotiated flows based on water years (for example, wet, normal, dry). These flows do not mimic natural streamflow, but the flows do increase and subside seasonally at predictable rates. At present, the San Francisco Public Utilities Commission is in the process of negotiating a new set of seasonal releases for the river below Hetch Hetchy. Using geomorphic and biological criteria to inform this process, the new flows would better mimic the natural hydrograph and benefit multiple downstream resources in this reach.

Below the Cherry Creek confluence, stream flows are far more variable on a daily basis, especially during the period from late spring through summer, due to releases to accommodate recreational boating. Relatively large pulses of water are released daily through Holm Powerhouse and the rate at which the flows increase and decrease are fairly abrupt. Also, the water temperature in the reach from Cherry Creek to Don Pedro is widely divergent from unregulated streamflow because the water being released originates deep in the water profile where temperatures are quite cold. By late summer and continuing into the fall, stream flow more closely resembles baseflow conditions and water temperatures begin to warm up.

As noted earlier, the Tuolumne River has several large watersheds that drain into the main river. These include the North, Middle, and South Forks of the Tuolumne, the Clavey River, and Cherry Creek (including Eleanor Creek). The next group of smaller watersheds that drain into the mainstem include Big Creek, Corral Creek, and Jawbone Creek.

The extent and severity of fire within the watershed is generally described (preceding and following this account) at the larger and smaller scales of the individual subwatersheds. For the main portion of the Tuolumne River canyon and the very small subwatersheds that are direct tributaries to the Tuolumne, the following generalization is made about how the Rim Fire affected the canyon. It appears that high vegetation severity fire impacted the majority (>60%) of the inner canyon for most of the length within the fire perimeter, especially on the north side (south facing) of the canyon. Burn severity was more moderate along the immediate stream edge and the burn severity mapping was confirmed with the aerial imagery. However, it is reasonable to assume that much of the obligate woody and herbaceous vegetation was greatly reduced due to the fire.

There is one known breeding population of FYLF on the Tuolumne and is located a short distance upstream of Early Intake. This population was discovered during surveys in

2008 (subadult) and additional observations have been made of tadpoles during surveys in 2010 and 2012 (Mike Horvath, SFPUC, personal communication). The population size at this location is assumed to be very small. The remainder of the Tuolumne River upstream of this locality is suitable for the FYLF and the river provides 36.5 miles of suitable habitat below 3,500 feet in elevation.

The following streams are not known to be occupied by the FYLF, but they are within the elevation range of the species and provide suitable habitat for the species.

Alder Creek is a small tributary that enters the Tuolumne just upstream of the Clavey. It has a watershed area of approximately 1,525 acres, and mapping indicates approximately 5.5 miles of intermittent channel. A 2013 field visit to this site during the first days of the Rim Fire indicated perennial water in a 0.1 mile reach of the river beginning where the stream starts its descent into the Tuolumne River. Post-fire imagery reveals this area as bright green, suggesting it either did not burn or the herbaceous riparian species were regrowing, thus indicating a high water table. While occupancy is unknown in Alder Creek, there were several deep pools in this perennial reach that provide suitable habitat for the FYLF. The hydrology of the stream is governed by rainfall. Gradient is low (<4%) above the river canyon and high (>25%) as it descends to the river.

The entire watershed is within the fire perimeter and the following vegetation burn severities were calculated for the watershed: very low to low (4% or 68 acres), moderate (9% or 140 acres), and high (87% or 1,319).

Cherry Creek is the second largest tributary to the Tuolumne River in the area affected by the Rim Fire and has a watershed area of approximately 150,000 acres (including the Eleanor Creek watershed). The upper portion of the watershed arises in the high elevations of the Emigrant Wilderness area. As such, runoff patterns are dominated by snowpack and snow melt processes. The river was glaciated in the upper reaches and the geomorphic functioning of the creek is dominated by a bedrock channel.

This stream is flow-regulated, attributable to Cherry Valley Dam. As with the Tuolumne River, water bypasses the reach downstream of the dam and is used to generate hydropower (and recreational boating flows) at Holm Powerhouse located approximately one mile upstream of the confluence with the Tuolumne. Streamflow is mainly maintained by negotiated releases from the dam and does not closely mimic the natural hydrograph. Like the Tuolumne reach above Early Intake, the river is generally warmer. The mile of stream below the powerhouse is characterized by extreme daily fluctuations in water level from the spring through the summer. Water temperatures are well below expected due to the deep water diversion in the impoundment.

The Rim Fire affected large portions of the Lower Cherry Creek, Kibbie Creek and Lower Eleanor Creek subwatersheds (6th level HUC) and smaller portions of the West Fork Cherry, East Fork Cherry, and Upper Eleanor Creek subwatersheds. For the Lower Cherry Creek subwatershed (24,450 acres), the fire affected approximately 20,606 acres (84% of subwatershed area) at the following vegetation burn severities: 5,416 acres at

very low to low (<50% vegetation mortality), 2,250 acres at moderate (50-75% vegetation mortality), and 12,940 acres at high severity (75-100% vegetation mortality). For the Lower Eleanor Creek subwatershed (11,085 acres), the fire affected approximately 91% of the subwatershed area (10,043 acres) at the following burn severity: 2,554 acres at very low to low, 1,176 acres at moderate, and 6,313 acres at high. For the Kibbie Creek subwatershed (10,342 acres), the following burn severities were mapped: 1,946 acres at very low to low, 665 acres at moderate, and 705 at high.

For the remaining three 6th field HUC subwatersheds in the Cherry Creek watershed, the fire affected 1,033 acres (2.5%) of the East Fork Cherry Creek HUC (40,077 acres), 86 acres (0.3%) of the West Fork Cherry Creek HUC (26,652 acres), and 1,977 acres (7.3%) of the Upper Eleanor Creek HUC (27,005 acres).

The FYLF occupancy of this stream is uncertain. There have not been extensive surveys of the creek, but it appears to have many of characteristics similar to the Clavey River and appears to be highly suitable for all FYLF life stages. The presence of the upstream dam appears to be a limiting factor for the frog's distribution in this stream as described by Lind (2005) and this may influence the extent of FYLF occupancy in Cherry Creek. Between its confluence with the Tuolumne River and an elevation of 3,500 feet, Cherry Creek provides approximately 17.8 miles of perennial habitat for all life stages in the mainstem of the river below an elevation of 3,500 feet (Eleanor Creek confluence).

Corral Creek is a direct tributary to the Tuolumne River and has a watershed area of 4,570 acres. There are approximately 9.6 miles of perennial channel mapped in this watershed and 5.7 miles of intermittent channel. The hydrology of the watershed is primarily influenced by rain, but the upper portion of the watershed is in the snow zone.

The entire Corral Creek watershed is within the fire perimeter. The following vegetation burn severities were mapped in the watershed: 193 acres at very low to low (4%), 282 acres at moderate (6%), and 4,096 acres at high (90%).

Then entire stream is within the elevation range of the FYLF, though the stream characteristics indicate that approximately four miles of the channel provide suitable habitat for all life stages.

Drew Creek is a direct tributary to the Tuolumne River with a watershed area of approximately 1,700 acres and 4.6 miles of mapped channel. The hydrology of this watershed is primarily driven by rain. The lower mile of the creek has very high gradient (>20%) as it descends into the Tuolumne River while the remainder of the main channel has a more moderate average gradient (9%) with sections of low gradient (<3%) channel embedded within.

The entire watershed area is within the fire perimeter. Fire severity was dominated by high severity across 61% (1,034 acres) of the watershed, with moderate severity fire affecting 10% and low or very low affecting 19%.

Drew Creek is different than most FYLF occupied streams because there are no tributaries for adult and subadult dispersal; therefore, the stream provides year-round habitat for these life stages. During the suppression efforts of the Rim Fire, several adult frogs were observed in Drew Meadow approximately 0.5 mile upstream of the known breeding activity and this may be the limit of adult dispersal because the channel is dry much of the year upstream of Drew Meadow. Of the four miles of available channel, only two miles provide suitable habitat for the frog and these are including the stream reach in, and immediately downstream of, Drew Meadow. Perennial streamflow is present in about one mile of the creek in and immediately downstream of the meadow, and persistent pools can be found patchily distributed in the remaining one downstream mile. Upstream of the meadow the channel is seasonally wet, and is largely dry by mid-June and does not provide suitable habitat for the frog for approximately six months of the year.

Drew Creek was most recently impacted by the 2005 Tuolumne Fire which burned the lower half of the watershed (stopping at the Cherry Oil Road and Drew Meadow). This fire burned with high severity in the lower reaches of the stream and in the chaparral surrounding the stream. While there were areas of high vegetation severity fire in the intermittent reach above the Tuolumne River canyon, there was low to moderate fire severity where FYLF have been documented. Occupancy by the FYLF was unknown prior to the fire, and subsequent surveys for western pond turtle detected the presence of the frog in 2007. Breeding was observed at this time and has been documented several times since the first detections. This population is considered to be relatively small (<20 individuals) based on low encounter rates and is effectively isolated from other nearby populations because the Tuolumne River is unsuitable for breeding, and possibly dispersal, at the Drew Creek confluence due to daily fluctuations from hydroelectric generation at Holm Powerhouse (Cherry Creek).

Granite Creek is a tributary to the lower end of Cherry Creek and has a watershed area of approximately 4,100 acres. The hydrology of this stream is driven by a mix of snow and rainfall. The mainstem of the creek is high gradient (>15%) and most of the small tributaries are as well. There is a considerable amount of spring influence in Granite Creek, especially in the tributary streams.

The entire watershed area is within the fire boundary and burn severity was mapped as follows: 3% (140 acres) at very low to low, 4% at moderate, and 93% (3,802 acres) at high.

The status of FYLF in Granite Creek is not certain. Most of the mainstem has been surveyed according to the visual encounter survey protocol we use (Fellers and Freel 1995), but no amphibian or reptile species have been detected. There are approximately six miles of suitable under 4,200 feet in elevation, all mapped as perennial. If occupied by FYLF, it is likely the stream provides refuge habitat for adults and subadults. Breeding habitat is located in Cherry Creek upstream of the confluence with Granite Creek.

Grapevine Creek has a watershed area of approximately 4,500 acres and is a direct tributary to the Tuolumne River. Its hydrology is primarily driven by rainfall. This stream is very steep throughout the watershed with the mainstem having an average gradient of approximately 18%. Most of the tributary channels have gradients in excess of 20%.

The entire watershed is within the fire boundary and burned at the following severities: 1,910 acres at very low to low, 1,022 acres at moderate, and 1,555 acres at high (34% of the total watershed area). The high burn severity was relatively well distributed throughout the watershed, but a large portion of the middle section of the watershed burned at high severity. Along the main portion of the stream, moderate and low severity fire primarily occurred within 50 feet of the channel. This suggests that minor effects to about half of the obligate riparian vegetation is expected with the remainder of the vegetation having the loss of the above ground portions of the trees.

The FYLF was not known to occur in this stream until 2011 when the first survey was conducted. Several tadpoles and adults were observed in a short reach of the creek (<0.5 mile) in the middle portion of the watershed. Breeding habitats in this stream are associated with lower gradient sections embedded between steep sections, but the prevalence of deep, plunge pools in the steeper sections provide habitat for adults and subadults. There are approximately 10.8 miles of channel providing suitable habitat.

Indian Creek is a small stream that enters the Tuolumne from the south side of the canyon. It has a watershed area of approximately 2,344 acres. There is 0.3 mile of mapped perennial stream and approximately 5 miles of mapped intermittent channel, but 2.7 miles are considered suitable for the frog. Like other direct tributaries to the Tuolumne, stream gradients are low to moderate above the rim of the canyon with a steep reach descending to the river. The hydrology of this stream is driven by rain.

A majority of the watershed (56%) was outside of the Rim Fire perimeter with the headwaters being spared. For the 1,048 acres in the perimeter, the following vegetation burn severities were observed: 404 acres of very low to low (17%), 246 acres of moderate (10%), and 397 acres of high severity fire (17%).

The very lower portion of the stream may provide suitable habitat for all FYLF life stages based on the mapped presence of perennial water. The remainder of the stream may provide suitable habitat for adults and subadults. There are no surveys of this stream.

Jawbone Creek is a direct tributary to the Tuolumne River and has a watershed area of approximately 13,136 acres. This stream originates at moderately high elevations (almost 7,000 feet) and the hydrology of the stream is influenced by a combination of rain and snow. There are approximately 43 miles of mapped stream channel in the watershed, and the majority (41 miles) is mapped as perennial. This seems like a mapping error based on field observations of small tributaries identified as perennial. The mainstem of the stream is relatively high in average gradient (16%), with high gradient sections prevailing in the lower reach near the confluence with the Tuolumne.

The Jawbone Creek watershed is entirely within the Rim Fire perimeter. The following vegetation burn severities were mapped in the watershed: 142 acres did not burn, 4,135 acres at very low to low (31%), 1,421 acres at moderate (11%), and 7,435 acres at high (57%).

The mainstem of Jawbone Creek provides approximately 14.3 miles of suitable habitat for all life stages of the FYLF between its confluence with the Tuolumne River and the 3N01 road crossing (3,500 feet in elevation). There is one small tributary to this portion of the mainstem that may provide suitable dispersal habitat for adults and subadults.

The Middle Fork Tuolumne River is a primary tributary to the Tuolumne River, though it joins, and technically becomes part of, the South Fork Tuolumne River approximately two miles from the confluence with the main Tuolumne. The Middle Fork is a 5th level HUC with a watershed area of approximately 46,740 acres and contains two 6th level HUCs, the Lower Middle Fork Tuolumne and the Upper Middle Fork Tuolumne. The average stream gradient is moderate (6.5%) on the forest (14 miles of channel), it is a bedrock channel stream, and the hydrologic runoff is attributable to snowmelt.

The Rim Fire burned approximately 70% of the watershed area of the Middle Fork, with the entire Lower Middle Fork Tuolumne subwatershed lying entirely within the fire perimeter and 54% of the Upper Middle Fork Tuolumne subwatershed directly affected by the fire. For the Lower Middle Fork Tuolumne subwatershed (15,595 acres), 3,431 acres (22% of the subwatershed area) were affected by very low to low fire severity, 2,444 acres (16%) were affected by moderate severity fire, and 9,513 acres (62%) were affected by high severity fire. For the Upper Middle Fork Tuolumne subwatershed (31,506 acres), 5,041 acres (16%) were affected by very low to low severity fire, 3,228 acres (10%) were affected by moderate severity fire, 8,759 acres (28%) were affected by high severity fire, and 14,325 acres (46%) were outside of the fire perimeter.

The Middle Fork Tuolumne is similar to the South Fork Tuolumne in regards to the FYLF. Limited survey has occurred but there have been no detections of the frog. From the confluence with the South Fork to the 3,500 foot elevation mark, the mainstem of the Middle Fork provides approximately 25.5 miles of suitable habitat.

The South Fork Tuolumne River is a direct tributary to the Tuolumne River and the stream's headwaters originate in Yosemite National Park. This is another bedrock channel river with a snowmelt driven hydrology. The watershed area of the South Fork is approximately 57,670 acres (5th level HUC) and there are two 6th level HUC nested within the larger watershed (Lower and Upper South Fork Tuolumne). The average channel gradient in the river is relatively low (<5%) over the 14 mile section on the forest. There are several additional miles of river in Yosemite. Big Creek and Ackerson Creek are the two primary tributaries to the South Fork, with several smaller tributaries contributing to flow (Rush, Hazel Green, and North Crane Creeks).

The Rim Fire affected almost the entire South Fork watershed (89% of 57,670 acres). For the two 6th level HUC, the vegetation fire severity was mapped as follows. For the Lower South Fork Tuolumne River subwatershed (19,870 acres), 38% (7,495 acres) burned at high severity, 18% burned at moderate severity (3,651 acres), and 44% (8,743 acres) burned at very low to low severity. Less than 1% of the subwatershed did not burn. For the Upper South Fork Tuolumne subwatershed (37,800 acres), 25% (9,450 acres) burned at high severity, 14% (5,292 acres) burned at moderate severity, 43% (16,254 acres) burned at very low to low severity, and 17% of the subwatershed did not burn.

The status of the FYLF in this watershed is not well known. A limited amount of survey for aquatic species has occurred on the South Fork, mainly in the vicinity of Rainbow Pool and in some of the tributary streams. There were no detections of frogs during these surveys. Between its confluence with the Tuolumne River, the mainstem of the South Fork provides approximately 29.4 miles of suitable habitat.

There are two **unnamed larger tributaries to the Tuolumne River** that may provide suitable habitat for the FYLF. No survey effort has been done to date on these streams, but interpretation of aerial imagery indicates obligate riparian vegetation and channel features. They are denoted by the township (T), range (R), and section (S) of their origin or confluence with the Tuolumne and named as one progresses upstream from the confluence of the North Fork Tuolumne River. There are several other smaller tributaries than those discussed here that are not discussed because they lack indicators of persistent water (that is, obligate riparian vegetation).

Tributary 1 (T1N, R16E, S33) is mapped as an intermittent stream and has approximately 4 miles of channel. This stream probably does not provide the elements needed for all life stages and may not provide dispersal habitat for adult/subadult frogs because the Tuolumne is unsuitable for breeding. **Tributary 2** (T1N, R16E, S36) is another small intermittent stream that offers three miles of channel. Like Tributary 1, this stream may not provide breeding habitat or dispersal habitat for post-metamorphic life stages.

North Fork Tuolumne River

The North Fork Tuolumne River is the last major tributary to the Tuolumne River before it enters Don Pedro Reservoir. It has a watershed area of approximately 64,000 acres reaching northward to near Pinecrest Lake. The hydrology of the watershed is primarily influenced by snow and it is a bedrock river like the Clavey. There are two primary tributaries to the North Fork, Basin Creek (described above) and Wrights Creek. The mainstem of the river has a moderate gradient (<10% on average).

The Rim Fire affected 684 acres (entirely within the Basin Creek subwatershed), which is approximately 1% of the total area of the North Fork.

There are multiple known breeding locations on the North Fork extending from the confluence with the Tuolumne up to an elevation of 3,000 feet; however, the extent of breeding in the river is poorly known due to limited access for surveys. There has been a recent invasion of the river by bullfrogs originating from private ponds on the western side of the watershed (including the towns of MiWuk Village and Confidence).

Basin Creek is a tributary to the North Fork Tuolumne River and has a watershed area approximately 9,030 acres in size. The hydrology of this stream is partly snow and partly rain associated. The FYLF is known to occur in most of the lower half of the watershed with breeding habitat near the confluence of the North Fork Tuolumne, and dispersal habitat for the adults and subadults in the headwater tributaries. Overall, Basin Creek is a high gradient stream with the main channel having a gradient of over 9% and most of the tributary streams having average gradients in excess of 20%. The known breeding location is in a section of stream with relatively low gradient (<3%).

The Rim Fire burned 684 acres (7% of the watershed) of the headwaters in the vicinity of Duckwall Mountain. For the area affected by the fire, approximately 45 acres burned at high severity, 69 acres burned at moderate severity, and 570 acres burned at low or very low severity. The burn severity mapping indicated almost all of the immediate riparian area (within 150 feet of the stream edge) was unburned and there was no high severity fire in this riparian area. Using imagery products specific to the Rim Fire (Worldview product), very little tree mortality occurred along the channels which limited any impact to habitats.

Within this fire-affected area, there is approximately one mile of mapped stream channels located in two subdrainages. Based on past observations of similar locations, these channels probably provide low suitability habitat for the frog (lack of persistent water) due to position in the watershed. Habitat suitability in these stream portions is low based on low probability of having perennial water. The Basin Creek watershed provides a total of 17.8 miles of suitable habitat.

Hunter Creek has a watershed area of approximately 9,500 acres and is a tributary to the North Fork Tuolumne River. The mainstem of the stream has a length of approximately 7.5 miles and the average gradient is about 7% over this distance. There are ten minor tributaries in the lower two-thirds of the watershed, all of which have average gradients of over 20%. Two additional tributaries are in the upper watershed and are also very steep. The hydrology of this watershed is a mix of rain and snow.

Approximately 5,000 acres burned in the Hunter Creek watershed (53%) with the following vegetation burn severities: 2,339 acres at very low to low, 1,044 acres at moderate, and 1,617 acres at high (17% of the total watershed area). The areas of high burn severity were located in the upper 20% of the watershed.

There is a breeding population of FYLF in the lower portion of the creek, with limited surveys indicating an elevational extent from 1,500 to 2,500 feet and covering a distance of approximately 3.5 miles. We do not know if the adults and subadults move into the

few tributary streams near the breeding reach. Overall, the mainstem of Hunter Creek provides 7.6 miles of habitat suitable for all lifestages between the North Fork Tuolumne River confluence and 3,500 feet in elevation (near the 2N11 bridge). There are 21.5 miles total of suitable habitat available in the watershed.

Clavey River

The Clavey River is one of the primary tributaries to the Tuolumne River and the largest undammed river. It also has a specific land allocation, Critical Aquatic Refuge, designed to provide it additional consideration during land management planning. The watershed has an area of 100,640 acres and the hydrology is predominantly influenced by snow. The Clavey River is considered to be a bedrock river (versus an alluvial river) and, as such, has a tremendous capacity to receive and transport streambed sediments during annual peak flows (McBain and Trush 2004). The channel is dominated by bedrock and boulder substrates, with deep pools separated by cobble bars and run habitats. Overall, the gradient is moderate in the mainstem (<10%), but the large watershed area and the variable peak runoffs associated with snowmelt result in a broad channel with a wide scour zone. The primary tributaries to the Clavey River in the fire area include the following streams: Cottonwood, Reed, Hull, and Twomile Creeks and their tributaries.

The Rim Fire affected approximately 52,531 acres of the watershed and the vegetation burn severity was as follows: 29,677 acres burned at very low to low (29% of the total watershed area), 7,004 acres at moderate (7%), and 15,849 acres at high (16%). The majority of the high burn severity was located in the Lower Clavey and southern half of the Reed Creek 6th level HUCs.

The FYLF is known to breed in much of the lower portion of the Clavey River. Breeding populations are known to occur from the confluence with the Tuolumne River to several miles above the 1N01 bridge. As a whole, the population of the FYLF in the Clavey is probably the largest remaining in the southern Sierra. While several of the tributaries provide suitable breeding habitat (Bull Meadow Creek, Bear Springs Creek), much of the suitable breeding habitat is found in the mainstem of the river. Between its confluence with the Tuolumne and an elevation of 3,500 feet, the Clavey River provides approximately 17 miles of suitable habitat for all life stages of the FYLF and 29 total miles of suitable habitat for adult/subadult life stages.

Bear Springs Creek is a tributary to the Clavey River and has a watershed area of approximately 2,400 acres. There are approximately 1.9 miles of suitable habitat for the frog in this stream. The hydrology of this small watershed is dominated by rain. The overall gradient of the stream above the Clavey canyon is low to moderate while the lower reach of the stream is very steep as it descends toward the Clavey River.

The entire watershed area is within the fire perimeter. The following vegetation burn severities were mapped in the watershed: 1,006 acres at very low to low (42%), 433 acres at moderate (18%), and 964 acres at high (40%).

About half of Bear Springs Creek provides suitable habitat for the FYLF. Limited survey effort has been spent looking for FYLF here, but no frogs have been detected which may be attributable to dense vegetation along and in the channel. While this stream may provide suitable habitat for all life stages, it seems more like it provides dispersal habitat for adult and subadult life stages. This is based on very small stream size and lack of habitat complexity (similar to Indian Springs Creek).

Bull Meadow Creek is a small tributary to the lower Clavey River with a watershed area of approximately 1,430 acres and approximately three miles of suitable habitat. Average channel gradient is high (22.9%) but a moderate gradient section (6.5%) occurs in the middle portion of the watershed where the frogs occur. FYLF occupancy is known from 1.3 miles of the stream extending from the downstream end of the meadow on private land to the drop off into the Clavey River. The meadow is severely downcut and the aerial imagery indicates little evidence of regular channel scour in headwater reaches. Hydrology in this stream is primarily driven by rain and not snow.

The entire watershed area is within the fire area with fire severity mapped as follows: 55% high, 25% moderate, and 20% low or very low. In the vicinity of the stream, high severity fire predominately occurred to the west of the stream and low or moderate severity occurred east of the stream. A review of aerial imagery indicated that low to moderate burn severity occurred in a majority of the area immediately around the channel (within 25 feet, with less than 50% of the area affected by high vegetation mortality). This resulted in irregular gaps in shade providing vegetation, not including herbaceous vegetation. However, much of the riparian vegetation consisted of obligate riparian species which should recover rapidly in the upcoming years.

Bull Meadow Creek is curiously different than most occupied streams on the forest, but shares a similar fire history with the two other streams most like it (McCormick Creek (Darby Fire) and Drew Creek (Tuolumne Fire)). These streams appear unique in that there are no tributaries for the adults to move away from the breeding sites and the breeding sites tend to occur near bedrock areas where the tadpoles develop in shallow pools. Adults and subadults tend to be associated with the deeper run and pool habitats with heavy shading while tadpoles and metamorphs are associated with relatively open cascade dominated areas.

Past impacts to Bull Meadow Creek include the 1987 Stanislaus Complex fire which burned with similar high and severity. The fire was essentially stand replacing for most of Bull Meadow Creek as evidenced by the extensive plantations established in the 1990s. Prior to the fire, obligate woody riparian vegetation provided areas of high stream shading (>75%) by deciduous trees.

The outlet stream from Indian Springs is a small tributary to the Clavey River with a watershed area of approximately 400 acres. Approximately 0.8 mile of perennial channel is present beginning at the meadow/spring and flowing in an eastward direction to the Clavey. There is a short (<1,000 feet), moderate gradient section of stream downstream

of the meadow before the channel assumes a more typical steep plunge to the Clavey River.

The entire watershed is within the Rim Fire area. About 50% of the watershed burned at high severity, 5% at moderate, and the remaining 45% at low to very low. High severity fire affected much of the area around and upslope of the channel, while the lower severity fire was mainly along the western edge of the watershed.

The FYLF was first reported from this location more than ten years ago, but confirmed in 2013 following the fire. There is a small impoundment (<500 square feet) built on the channel which provided a source of water for drafting; however, the pool has accrued considerable sediment and is shallow with abundant herbaceous riparian vegetation. At approximately 4,000 feet, this occurrence record is the highest recorded for the forest. The stream probably does not provide suitable breeding habitat for the frog due to the extreme gradient over most of its length and the very small channel near the spring and meadow. Instead, this stream provides dispersal habitat for subadults and adults away from the breeding habitat in the Clavey.

Quilty Creek is a direct tributary to the Clavey River with a watershed area of approximately 1,089 acres. Approximately 1.8 miles suitable habitat is available to the frog in this stream. The hydrology of this stream is dominated by rain. Like other small direct tributaries to the Clavey, the gradient above the canyon is relatively moderate (<5%) with a very steep descent into the Clavey River. The upper half of this stream is on private property.

The entire watershed area is within the fire perimeter. The following vegetation burn severities were mapped in the watershed: 325 acres at very low to low (30%), 176 acres at moderate (16%), and 588 acres at high (54%).

This stream is very similar to Indian Springs Creek with regard to FYLF habitat. It is probable that Quilty Creek provides dispersal habitat for adult and subadult life stages and does not provide breeding habitat due to small stream size and low habitat complexity. The entire stream length is within the elevation range of the species.

Reed Creek is a primary tributary to the Clavey River and contributes the flow from Reynolds and Bourland Creeks to the Clavey. Including the watershed area of these tributaries, the Reed Creek 6th level HUC has an area of 24,478 acres. This 6th level HUC contains three 7th level HUCs, Reed Creek (7,473 acres, all of the area downstream of the Reynolds and Bourland Creek confluence), the Reynolds Creek watershed (8,442 acres, including Little Reynolds and Lost Creeks), and Bourland Creek (8,563 acres, including Looney Creek). The hydrology in the Reed Creek watershed is dominated by snow. The mainstem of Reed Creek has a moderate average gradient (6%) and is a typical bedrock channel stream like the Clavey with high capacity for sediment storage and transport.

Fire severity patterns were apparent at the 7th level HUC scale and are as follows. In the Reed Creek HUC (7,473 acres), very low and low fire severity related to vegetation

affected 33% of the watershed, moderate severity fire affected 10%, and high severity fire affected 57% of the watershed. The high proportion of high severity fire in this subwatershed reflects one of the days when extreme fire behavior was observed and was driven by wind from the south. For the Reynolds Creek subwatershed (8,442 acres), very low and low severity fire affected 62% of the watershed (5,226 acres), moderate severity fire affected 8%, and high severity fire affected 7% of the watershed. Approximately 23% (1,970 acres) of the watershed was outside of the fire perimeter, mainly in the headwaters of Reynolds Creek. For the Bourland Creek subwatershed (8,563 acres), a small portion of the watershed was affected by the fire, with high severity fire mapped for 58 acres (<1%), moderate severity fire mapped for 147 acres (1.7%), and very low or low severity fire mapped across 2,030 acres (24%).

The status of FYLF in Reed Creek is not well known, but multiple surveys have occurred since 1995 and no detections have been made. Using a 3,500 foot criterion for FYLF breeding in larger streams and rivers, approximately 1.5 miles of the mainstem above the Clavey confluence provides suitable habitat for all life stages, and 2.7 miles of suitable habitat for adults and subadults. The channel complexity and low gradient sections make for ample breeding habitat.

Additional to Bear Springs, Bull Meadow, Reed and Quilty Creeks, **there are eight tributaries to the Clavey River** that provide suitable habitat for the frog. Adams Gulch, Cottonwood Creek, Russell Creek, and five unnamed streams (originating in Township 1 South, Range 17 East, Section 9 (Tributary 1); T1S, R17E, S10 (Tributary 2); T1N, R17E, S13 (Tributary 3); T1N, R17E, S24 (Tributary 4); and T1N, R17E, S35 (Tributary 5)).

Adams Gulch has a small watershed area (approximately 815 acres) and provides approximately 0.8 mile of perennial channel that is suitable dispersal habitat for adults and subadults. The entire watershed area is within the fire perimeter and the following burn severities were approximated for the watershed: 50% very low to low, 15% moderate, and 35% high. **Cottonwood Creek** is a small stream coming (watershed area 5,300 acres) in to the Clavey just downstream of the 1N01 bridge. This stream is near the upper elevation limit that we would expect FYLF to breed especially in a setting for a stream this size. Aside from the elevation, Cottonwood Creek appears to have very suitable habitat for all life stages especially the lowest reach of the stream as it joins the Clavey. There is good habitat complexity and it resembles occupied stream of similar size (example, Hunter Creek). The lower mile of stream is within the elevation range of the frog, providing suitable habitat for all life stages and 2.3 miles total suitable habitat for adult/subadult lifestages. Burn severity was primarily low in the watershed, affecting 3,324 acres (63% of watershed) with approximately 1,200 acres of moderate (557 acres) and high (662 acres) severity and 764 acres were unburned. **Russell Creek** (560 acres) is another small tributary that provides about 1.4 miles of intermittent channel, most of which (0.8 mile) is in the elevation range of the FYLF. The entire channel is in the inner gorge of the Clavey River and stream gradient is high (>20%). The entire watershed is within the fire perimeter and the extent of fire severity was estimated to be 50% very low to low, 20% moderate, and 10% high. The combination of small stream size and high

gradient make this stream suitable for the dispersal of adults and subadults from the Clavey.

Tributary 1 enters the Clavey near the confluence with the Tuolumne and there are 1.5 miles of potentially suitable habitat. The watershed area is approximately 773 acres. The stream is very steep (>45% gradient on average) and, based on aerial imagery, there is very little evidence of scour in the half of the stream. Runoff hydrology is determined by rain. There is a low likelihood that this stream provides suitable habitat for the frog. The entire watershed is within the perimeter of the fire and the vegetation burn severity map indicates a majority of the watershed burned at high severity (56%). Moderate burn severity was mapped for 175 acres (23%) and very low and low severity was mapped for the remaining 163 acres. **Tributary 2** enters the Clavey a short distance upstream of Tributary 1, but differs in that the headwaters arise in close proximity to the springs at Walton Cabin. There is one mile of mapped perennial channel and the watershed area is approximately 373 acres. This stream may provide suitable dispersal habitat for adults and subadults for the breeding habitat in the Clavey. Much of the watershed burned at high (78%, 292 acres) and moderate (15%, 57 acres) severity. **Tributary 3** enters the Clavey River near river mile 12.5 and has a watershed area of approximately 1,343 acres. There are three miles of mapped channel, 2.3 of which likely provide suitable habitat. The average gradient exceeds 20%. The hydrology of this stream is largely driven by rain. This stream may provide dispersal habitat for adults and subadults. The entire watershed is within the Rim Fire perimeter. High vegetation severity fire affected approximately 62% of the watershed (840 acres), with very little moderate conditions (13%, 178 acres). **Tributary 4** (490 acres) lies within the same 8th level HUC as Tributary 3 and enters the Clavey a short distance downstream. It provides approximately one mile of intermittent channel and is very steep (>35% average gradient) over its entire length. These characteristics make occupancy by FYLF unlikely. The entire watershed area is within the fire perimeter and approximately 58% of the watershed was affected by high (34% or 168 acres) and moderate (24%, 116 acres) severity fire combined. **Tributary 5** enters the Clavey just downstream of the 1N01 bridge and 1N01 crosses the stream a short distance upstream the confluence. The watershed has an area of approximately 688 acres and there are 1.7 miles of suitable habitat in this watershed (one mile of intermittent and perennial). The average gradient of the two miles of channel is very high (>38%). The entire watershed lies within the fire perimeter and the proportion of the watershed affected by the classes of vegetation burn severities were observed: very low to low affected 23% of the watershed (159 acres), moderate affected 23% of the watershed, and high affected 54% (370 acres). Frogs have been observed at the 1N01 crossing in the past, but no positive identifications occurred during post-fire surveys of the upper portion of the mainly dry stream.

North Fork Merced River

The North Fork Merced River is a free flowing tributary to the Merced River, has a watershed area of approximately 80,000 acres, and is a bedrock river like the Clavey River. The hydrology of the river is dominated by rainfall. This watershed includes three subwatersheds (6th level HUC) including the lower North Fork, Upper North Fork

(including Bean, Jordan, Moore, and Smith creeks), and Bull Creek, which is described above. The mainstem of the river is predominantly bedrock and has a moderate gradient (<10%) as it descends to the Merced River.

The Rim Fire burned within small portions of the Upper North Fork Merced (Moore Creek, described above) watershed and Bull Creek (as described below). Less than 2,200 acres burned in the North Fork, affecting <3% of the total watershed area.

There is a known breeding population of the FYLF in the North Fork near the confluence of Moore Creek. Upstream of the breeding site, adults have been observed in the persistent pools in an otherwise dry channel. This population is assumed to be small (<10 adults) based on the small number of tadpoles observed. In total, the watershed provides approximately 74 miles of suitable breeding habitat, including the streams listed below. Most of the 74 miles is well outside of the fire perimeter and extends down towards the mainstem Merced River.

Bull Creek is one of the primary tributaries to the upper North Fork Merced River with a watershed area of approximately 21,026 acres. There are approximately 45 miles of suitable habitat in the watershed; fifteen miles are mapped as perennial channel. The average gradient in the perennial section of the mainstem is low to moderate (<6%) with several areas of relatively steep gradient (>15%). The hydrology of the stream is influenced by both rain and snow.

A small portion of the watershed was affected by the Rim Fire (1,191 acres, 5%) which mainly occurred along Pilot Ridge, the watershed divide with the South Fork Tuolumne River. Of the total area affected by the fire, very low to low fire severity conditions affected 616 acres, moderate severity conditions affected 293 acres, and high severity fire was mapped for 282 acres.

There is a known population in the upper portion of the watershed in the vicinity of Anderson Flat. All life stages have been documented in this area. Also, surveys from the 1990s detected adults in the lower half of the watershed near Montgomery Gulch. Montgomery Gulch is not mapped as a perennial stream, but it is reasonable to assume that this large tributary to Bull Creek provides perennial pool habitat in its channel due to the length of channel, underlying geology of the watershed, and similarity to other nearby streams (example, Deer Lick Creek). The entire mainstem of this creek is considered to be suitable for FYLF breeding.

Moore Creek is a tributary to the North Fork Merced River and has a watershed area of approximately 5,900 acres. Average gradient is low with most of the mainstem having a gradient less than 3%. Two principal tributaries, Jordan and Deer Lick Creeks, enter the very lower end of the watershed, while one notable tributary, White Oak Creek, is in the upper part of the watershed. Both the Deer Lick and White Oak Creek subwatersheds were affected by the fire. The hydrology of this stream is driven by rainfall.

Approximately 995 acres burned in this watershed (17%) and 589 acres burned at high severity primarily along the northern watershed divide with the Tuolumne and South Fork Tuolumne Rivers.

Evidence of breeding has been documented twice at the lower end of the stream, very close to the confluence with the North Fork Merced River. Other life stages have not been documented but it is suspected that the adults and subadults move into Deer Lick Creek where spring influence provides perennial pools. Moore Creek provides approximately 3.5 miles of habitat suitable for all life stages and almost 12 miles of total suitable habitat (not including Deer Lick and Jordan Creeks). Bullfrogs are known from this watershed and are a principal predator of the frog, especially newly metamorphosed individuals.

Deer Lick Creek, as noted previously, is a tributary to Moore Creek in the upper North Fork Merced River watershed. There are approximately 10 miles of suitable habitat in the watershed. Overall the stream has a moderate to high average stream channel gradient (10%) with some deep pool habitat. The hydrology of this watershed is primarily influenced by rainfall.

Some survey effort has been expended on this stream but FYLF have not been detected. This stream provides good dispersal habitat for the frogs breeding in the lower reach of Moore Creek and may provide breeding habitat for the frog. The entire perennial reach is considered to be suitable habitat because the entire watershed is below the local elevation range.

Approximately 22% (894 acres) of the watershed burned during the fire, mainly burning the headwaters along the watershed divide. Of the total acreage burned, fire severity affected the following area: 385 acres of low, 285 acres of moderate, and 224 acres of high.

The table below shows the primary streams providing suitable habitat for the FYLF and summarizes the miles of suitable and occupied FYLF habitat, occupancy status, and whether we have conducted surveys on the streams.

Table 7. Streams occupied by and providing suitable habitat for the foothill yellow-legged frog affected by the Rim Fire with miles of stream and acres of upland habitat

Watershed (5th level Hydrologic Unit Code)	Stream name	Watershed area (acres)	Occupancy (Yes/Unknown)	Survey (Yes/No)	Miles of suitable stream	Acres of upland habitat (30-meter buffer)
Tuolumne River	Tuolumne River	819,000	Yes	Yes	36.5	870
	Alder Cr.	1,525	Unknown	Yes	5.5	132
	Corral Cr.	4,570	Unknown	Yes	9.6	230
	Drew Cr.	1,697	Yes	Yes	4.6	110
	Grapevine Cr.	4,488	Yes	Yes	10.8	260
	Indian Cr.	2,344	Unknown	No	2.7	64

Watershed (5th level Hydrologic Unit Code)	Stream name	Watershed area (acres)	Occupancy (Yes/Unknown)	Survey (Yes/No)	Miles of suitable stream	Acres of upland habitat (30-meter buffer)
	Jawbone Cr.	13,136	Unknown	Yes	14.3	343
Middle Fork Tuolumne River	Middle Fork Tuolumne River	46,635	Unknown	Yes	25.5	612
North Fork Tuolumne River	North Fork Tuolumne River	63,849	Yes	Yes	75	1,796
	Basin Cr.	9,030	Yes	Yes	17.8	427
	Hunter Cr.	9,482	Yes	Yes	21.5	515
South Fork Tuolumne River	South Fork Tuolumne River	57,855	Unknown	Yes	29.4	704
Cherry Creek	Cherry Cr.	90,892	Unknown	No	17.8	428
	Eleanor Cr.	59,906	Unknown	No	2.3	55
	Granite Cr.	4,110	Unknown	Yes	6.0	144
Clavey River	Clavey River	100,645	Yes	Yes	29	696
	Reed Cr.	24,527	Unknown	Yes	4.2	101
	Adams Gulch	815	Unknown	No	0.8	18
	Bear Springs Cr.	2,403	Unknown	Yes	1.9	45
	Bull Meadow Cr.	1,430	Yes	Yes	3.0	71
	Indian Springs Cr.	356	Yes	Yes	0.8	20
	Quilty Cr.	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 Cr.	5,307	Unknown	Yes	2.3	56
	Russell Cr.	560	Unknown	No	0.8	20
North Fork Merced River	North Fork Merced River	79,110	Yes	Yes	74.4	1,784
	Bull Cr.	21,064	Yes	Yes	44.7	1,072
	Deer Lick Cr.	3,981	Unknown	Yes	9.7	233
	Moore Cr.	5,896	Yes	Yes	11.9	286
	Scott Cr.	1,627	Unknown	Yes	1.9	46

Hardhead

Species Account

There are no known occurrences of hardhead from any of the streams in or potentially affected by the Rim Fire. There has been very little survey effort for this species to date by any entity. Snorkeling surveys of the lower Clavey River in 2006 did not definitively detect the fish, though small Sacramento pikeminnow or hardhead were observed (S. Holdeman, pers. observation). CNDDB (2008) reports only one occurrence from near

the forest's boundary in the Merced River (1981), more than 20 miles to the southeast. The USGS reports hardhead from the Tuolumne and Merced Rivers well downstream of Don Pedro and LaGrange Reservoirs, respectively, but did not detect any hardhead from the Merced River upstream of McClure Reservoir (USGS 1999). Additional fish community data collected by the U. S. Geological Survey did not indicate the distribution of hardhead upstream of the primary dams on the Merced and Tuolumne Rivers (http://ca.water.usgs.gov/sanj_nawqa/eco_cycle1.html#Ecological Studies: Fixed Reach Assessment). Moyle (2002, citing Reeves 1964) reported this species to decline dramatically following impoundment of Don Pedro Reservoir, indicating this species likely occurred historically in the Tuolumne River and its tributaries.

Habitat Account

The hardhead is a large minnow that inhabits slow water habitats at low elevation (<1,500 feet) in larger streams in the Sacramento – San Joaquin drainage of the Sierra Nevada foothills (Moyle 2002). This fish is omnivorous, feeding on a wide range of items including aquatic and terrestrial insects, snails, crayfish and plant material. Preferred habitat for adult fish includes deep, clear, warm pools in larger streams, and the presence of this fish is an indicator of high water quality and biological integrity (Moyle 2002).

As noted above, suitable habitat for the hardhead likely occurred in the Tuolumne River prior to the impoundment of Don Pedro Reservoir. Because of the hydropower operations on the Tuolumne River, especially during the spawning season, the Tuolumne probably provides only seasonal habitat for the hardhead if it is still present in the upper Tuolumne River. It is assumed that the North Fork Tuolumne River, Clavey River, and the mouth of Hunter Creek provides suitable spawning habitat for the species. The presence of barriers (waterfall >15 feet) to upstream salmonid (trout and salmon) passage near the mouth of the North Fork Tuolumne and Clavey Rivers, may have limited the distribution of hardhead in these streams. However, other species in the pikeminnow-hardhead-sucker fish assemblage (Moyle 2002) are present to some extent in the rivers which may suggest previous (or continued) occupancy by the species. Due to poor swimming ability in swift water (Moyle 2002) it is unlikely that the fish occupied much of Hunter Creek or other small tributary streams due to steep gradient reaches near the confluences of the Clavey, North Fork Tuolumne, and Tuolumne Rivers. We assume that the Tuolumne River provides 13 miles of suitable habitat between Don Pedro reservoir and river mile 95 (Lumsden Bridge/Meral's Pool area). Assuming the barrier at the mouth of the North Fork Tuolumne did not preclude hardhead occupancy further upstream, the river provides approximately five miles of habitat suitable for all life stages. Assuming the waterfall barrier on the Clavey was not a barrier to hardhead, the river provides approximately three miles of habitat suitable for all life stages.

Western pond turtle

Species account

The western pond turtle (WPT) occurs in a variety of habitats within the fire perimeter, including streams, ponds and seasonal wetlands. Many of the streams that have foothill yellow-legged frogs also have WPT. Within the fire perimeter, turtles have been

observed in the following streams: Ackerson Creek, Drew Creek, and the South Fork Tuolumne River. Turtles have also been observed in close proximity to the project area in the following streams that had portions of their watershed affected by the Rim Fire: Big Creek, Bull Creek, Hunter Creek, Moore Creek, North Fork Merced River and the North Fork Tuolumne River. WPT have been observed at the following ponds within the fire perimeter: Birch Lake (Camp Mather), "Grandfather Pond" (T1S, R19E, S9), Mud Lake (T1S, R19E, S10), and the two ponds on Kibbie Ridge (T1N, R19E, S4 and T2N, R19E, S33). Turtles are also known from Abernathy Meadow (T1S, R19E, S9), a seasonal wetland.

Habitat account

The western pond turtle (WPT) can occur in and adjacent to a variety of aquatic habitats, both lotic (moving water, streams and rivers) and lentic (still water, ponds and lakes). Perennial water is preferred, but there is an indication that the turtle can persist in environments where water is seasonally available by means of a process referred to as aestivation (Holland 1994, Rathbun et al. 2002). Basking is an important part of WPT ecology because several physiological processes are dependent upon increased internal body temperature (Boyer 1965, Hammond et al. 1988). Jennings and Hayes (1994) and Holland (1994) suggest habitat suitability may be higher where basking sites are more available. The WPT primarily uses terrestrial habitats for overwintering, nesting, and aestivation. The turtle is wary of human presence and readily retreats from basking structures into the stream where it takes refuge in deep pools or under rocks or overhanging banks.

In streams, the WPT typically leaves the aquatic habitat in fall to overwinter in areas near the water. These overwintering sites are typically within 200 meters (650 feet) but can occur at distances up to 400 meters (Holland 1994, Reese 1996, Reese and Welsh 1997, Rathbun et al. 2002). Based on the citations above, upland habitat suitability for overwintering is variable in terms of vegetation composition, but must be able to provide the turtle a duff layer into which it can embed itself into. Hillslope and aspect do not appear to play a significant role in the selection of overwintering sites (Reese 1996) and there is some indication of turtles returning to the same site annually.

Nesting habitat is also somewhat variable, but mainly consists of herbaceous dominated areas on low angle slopes facing south or west with well-drained soils (Holland 1994, Reese 1996, Reese and Welsh 1997, Rathbun et al. 2002). Nests can be several hundred meters from the aquatic feature, but more typically nesting occurs within 100 meters of the aquatic habitat (Holland 1994, Reese 1996, Rathbun et al. 2002). Habitats used for aestivation (upland use when water is not present) are essentially the same as for overwintering and mainly requires leaf duff or thatch to bury themselves.

Aquatic habitats are required for mating, eating, and the development of hatchlings. Mating and eating must occur underwater. Once the hatchlings emerge from the nest in the spring, they make their way to water. Hatchlings require warm, shallow, still water for thermoregulation and foraging (Holland pers. comm. in Jennings and Hayes 1994). If the streamflow of a river is regulated by upstream dams (and hydropower generation),

shallow water habitat suitable for rearing hatchlings is either limited or not present at all due to fluctuating water surface and cold temperatures from hypolimnetic releases.

Tuolumne River

The **Tuolumne River** likely provides suitable habitat for subadult and adult life stages of the WPT. The daily fluctuations in water level associated with hydropower generation in the channel likely limits or preclude the presence of warm, shallow water habitat especially from late spring into early summer when the hatchlings emerge from the nest. That said, the oak woodland/grassland vegetation type that typifies the north side of the river and the old floodplain appears to be highly suitable for nesting. Both sides of the river provide excellent overwintering habitat. The steep canyon and long distances to ponds on the canyon rim may be sufficient to preclude extensive movements from the river to these ponds, and vice versa. With over 36 miles of channel in the fire perimeter, there are approximately 8,600 acres of suitable upland habitat adjacent to the river.

Above Early Intake, multiple observations of WPT have been made during cooperative surveys (San Francisco Public Utilities Commission, National Park Service (Yosemite), and Forest Service). These observations extend upstream to Poopenaut Valley in the park. Below Early Intake, observations of WPT are rare. Anecdotal information from the USFS river ranger on the Tuolumne indicates adult turtles are seldom observed and occur most frequently near the confluence of the North Fork Tuolumne River (Bob Stanley, personal communication). These turtles may be individuals dispersing downstream from the North Fork, where WPT have been well documented.

Ackerson Creek is a modest sized tributary to the South Fork Tuolumne River with a watershed area of approximately 7,356 acres. Approximately 75% of the watershed lies within the boundary of Yosemite National Park. The average channel gradient on the Stanislaus is fairly low (<3%) over the three or so miles on the forest. The known occurrence of turtles in this watershed comes from the main tributary lying south of Ackerson Creek and turtles are regularly found in the stream meandering through the meadow. We can reasonably assume that the turtles move throughout Ackerson Creek and may have connectivity with other WPT in the South Fork Tuolumne River. This population is an elevation outlier from other populations on the forest, occurring at an elevation of approximately 4,800 feet.

The entire watershed area is within the Rim Fire perimeter and the following vegetation burn severity classes were observed. Very low to low fire severity affected 1,932 acres (26% of the total watershed area), moderate severity fire affected 1,652 acres (22%), and high severity fire affected 3,772 acres (52%).

Drew Creek was previously discussed under FYLF. Drew Creek provides approximately two miles of suitable habitat that coincides with the FYLF suitable habitat and is related to those areas with persistent water. Persistent water is particularly important for the WPT because once the newly hatched turtles emerge from the nest, they need to be in close proximity to a pool for a critical period of physical growth and

development. While they can move short distances during the early period associated with water, they have limited energy reserves and need to actively feed in warm water habitats. Adult and subadult turtles are more capable of moving long distances, even in channels without water, to other aquatic habitats.

Almost all of the area surrounding the stream is suitable upland habitat (for overwintering and aestivation), and using an average distance of 984 feet (both sides of the stream) for overwintering movements, there are approximately 1,000 acres of upland habitat. Of this total, we consider less than 10% of the area to be suitable for nesting, mainly along the north side (south facing) side of the stream, but particularly in areas of herbaceous vegetation created by the 2005 Tuolumne Fire. The limited amount of nesting habitat is due to dense chaparral in upland habitat.

Eleanor Creek provides approximately 3.5 miles of mainstem channel that appears to be highly suitable for the WPT. There are many deep pools and the channel is relatively wide with ample bedrock and boulder outcrops for basking. We have received several reports of turtles occupying the reach downstream of the dam. Much of the watershed area between the confluence with Cherry Creek and the dam burned at high severity. There are approximately 600 acres of upland habitat in the watershed.

The **Middle Fork Tuolumne River** provides excellent aquatic habitat for the turtle. The general low gradient, long deep pools, limited road access, and high abundance of large woody debris improve the overall habitat quality of the river. Approximately 14 miles of main channel is on the forest, providing suitable habitat the entire reach, even extending into the park. Detections of WPT in the Middle Fork mainly come from the lower reach in the vicinity of the San Jose Camp and the crossing of the Cherry Lake Road (1N07). We have had incidental reports of turtles being observed in the vicinity of Camp Towanga, but our surveys have not detected the turtle at that site.

We consider the entire length of stream to be suitable for all life stages of WPT. As such, the upland habitat comprises approximately 5,365 acres. From Camp Tawonga and proceeding upstream, the amount of nesting habitat was limited by the extensive stands of mixed conifer forest along the stream. Before the fire, there was a low likelihood of nesting in this reach, but conditions for nesting may have improved locally in the aftermath of the fire. Most of the open, minimally forested area is downstream of Tawonga, especially in the vicinity of Spinning Wheel (just upstream of the Cherry Lake Road).

The **North Fork Tuolumne River** provides moderate to high quality aquatic habitat for the WPT. The known occupied reach is between Riverside Day Use area and the Cottonwood Road (1N04) crossing of the North Fork. Our knowledge of WPT distribution in the river is limited due to minimal access for surveys. Discussions with landowners near Sierra Village (river elevation 3,800 feet) suggest the turtle occupies at least the lower 17 miles of the North Fork. Over this length, there are approximately 2,500 acres of upland habitat. Based on aerial imagery, the availability of nesting habitat is very limited above 2,600 (river surface elevation) due to extensive mixed conifer forest

and lack of open meadow or chaparral areas. The lower 11 miles of the river appear to be moderately suitable for nesting in the upland habitat.

Hunter Creek, a North Fork Tuolumne River tributary, supports a population of WPT and observations have most frequently occurred in the vicinity of the 1N03 crossing of the creek. The uplands surrounding this lower reach support blue oak woodlands with a grassy understory, conditions that are favorable for nesting. The entire 7.5 miles of main channel in Hunter Creek provide suitable aquatic habitat for the WPT and the surrounding upland habitat amounts to almost 1,100 acres. The lower three miles of Hunter Creek provides suitable nesting habitat, primarily on the north side of the river.

The **South Fork Tuolumne River** provides approximately 14 miles of suitable aquatic habitat for the WPT on the forest. Habitat characteristics of the South Fork are very similar to those in the Middle Fork Tuolumne River, with abundant low gradient stream, limited disturbance in the riparian area, long and deep pools, and adequate basking habitat. Surveys have only detected WPT immediately upstream of the Highway 120 crossing, but the entire reach is assumed to be occupied by the turtle. There are approximately 6,400 acres of suitable upland habitat. Within this upland habitat, nesting habitat appears to be limited to very few areas of open, herbaceous upland totaling less than 200 acres. Most of the nesting habitat is found in the lower five miles of the river.

North Fork Merced River

The turtle occupies most of the upper portion of the **North Fork Merced River**, including many of the tributaries listed below. Using the stream mileage estimated for the FYLF (74.4 miles), there are approximately 17,000 acres of upland habitat available and very little breeding habitat is embedded within the upland habitat because of dense chaparral and live oak stands. Most of the discussion of suitable habitats is made for the tributaries.

Western pond turtle distribution in **Bull Creek** essentially overlaps the distribution of the foothill yellow-legged frog. The turtle is known from the upper reach of Bull Creek in Anderson Valley and detections have occurred downstream to Jenkins Ranch (2S05 road crossing). Turtles likely use the lower three miles of inaccessible stream because the gradient is relatively low and aerial imagery indicates the presence of large pools. Along the 7.5 miles of Bull Creek's mainstem, there are approximately 1,800 acres of suitable upland habitat for the WPT and almost 10,000 acres of upland habitat in total for the watershed. We do not have any survey in Montgomery Gulch, the primary tributary to Bull Creek. This subwatershed provides an additional six miles of intermittent channel that may provide low to moderate quality aquatic habitat for the turtle.

Deer Lick Creek is a tributary to Moore Creek and provides about 10 miles of perennial channel. Other than the first mile of channel, this stream offers little in the way of nesting habitat as no open, herbaceous areas are present. However, the presence of adults in the lower mile indicates the stream is suitable for adults and subadults. This is likely due to the extensive bedrock streambed (provides basking habitat) and presence of deep

pools at the bottom of cascades. The surveyors indicated habitat suitability decreased greatly approximately three miles up from the confluence and several large cascade/waterfalls (30+ feet) may preclude extensive movement to upstream reaches. As such, we consider the lower three miles to be the primary suitable aquatic habitat in Deer Lick Creek, and the surrounding upland habitat includes approximately 440 acres.

Moore Creek provides approximately five miles of mainly intermittent channel for the WPT. Our experience surveying this stream indicates persistent water in pools from the confluence with the North Fork Merced River to White Oak Creek. However, the headwater tributaries near Highway 120 have several small ponds on them, which may serve to attract individual turtles. We have observed shells in upland areas in this vicinity which may suggest overwintering was occurring in this part of the stream. The lower end of the stream has a small impoundment and there is a seasonal pond in close proximity to the stream in this vicinity as well. There are approximately 2,800 total acres of upland habitat in the watershed, approximately 1,200 acres of upland habitat along the five miles of suitable aquatic habitat, and less than 100 acres of open area that could support nesting.

Scott Creek is a small tributary to the North Fork Merced River with a watershed area of approximately 1,627 acres and approximately one mile of mapped perennial channel. Field surveys in this stream did not indicate perennial stream flow in the mapped portion and the stream is likely intermittent in most years. WPT were observed within the lower 0.5 mile of the stream in 2012 and were associated with bedrock and pool habitat. The surveyors indicated overall suitability of the stream decreased considerably one mile up the stream due to lack of pool habitat, lack of basking structures, and high levels of stream shading. There are approximately 240 acres of upland habitat around the lower mile of stream, and there appear to be several small, isolated open areas that may provide suitable habitat for nesting (<10 acres total).

Approximately 60% of the watershed lies within the Rim Fire perimeter and the fire was contained to the upper portion of the watershed. Burn conditions were generally very low to low with 42% (680 acres) of the watershed area affected by this degree of fire severity, and moderate and high severity fire affected 13% and 5%, respectively.

Birch Lake is a man-made pond lying entirely on private lands, known as Camp Mather and owned by the City and County of San Francisco and operated by the San Francisco Recreation and Parks Department. It has a surface area of approximately four acres and, based on personal observations, supports a population of WPT. Non-native and predatory bullfrogs are abundant at this pond. There are approximately 120 acres of upland habitat surrounding the lake, but much of it has very low suitability due to extensive development at the camp. The immediate area surrounding Camp Mather was kept from burning, but there was a considerable amount of high severity fire on the hillslopes surrounding Birch Lake, including the ephemeral and intermittent channels. The available maps lack clarity when attempting to determine the flow paths of nearby streams and their potential contribution to water and sediment delivery to the lake. We

know very little about the terrestrial use of the turtle at this site and do know that there is very high use in and around the lake from Memorial Day through Labor Day.

Mud Lake is a small (3 acres) perennial pond located less than 0.5 mile to the west of Birch Lake. There is a relatively large population of WPT at this site, with one photograph showing over 30 adult turtles. The pond loses over half of its surface area in a typical year and less than 500 square feet of surface area was present in late 2013. This leads us to believe the lake retains water in almost all years since this is the second of two very dry years. There are approximately 115 acres of upland habitat surrounding the lake. The pond has a robust population of bullfrogs. The area immediately around Mud Lake, especially east and west of the pond, was affected by relatively low severity fire. High severity fire was prevalent north of the pond as the fire rapidly climbed the canyon of the Tuolumne River. Visitor use around this pond is relatively high given the proximity to Camp Mather, and guided horseback tours travel along a portion of the lake regularly throughout the summer. It is reasonable to assume that turtles move between Birch Lake and Mud Lake given their proximity.

There are **two ponds located on Kibbie Ridge**, the watershed divide between Cherry Creek and Eleanor Creek. The ponds differ in size and we have informally named them "**Big Kibbie**" and "**Little Kibbie**". Big Kibbie pond is approximately one acre in size, Little Kibbie pond is approximately 0.5 acre, and they lie approximately 0.2 miles apart. Upland habitat around Big Kibbie Pond comprises approximately 100 acres, while the upland habitat around Little Kibbie is approximately 90 acres. The upland habitats for the ponds overlap with each other due to the proximity of the ponds. The WPT occupying the ponds are likely to move between the two due to this proximity.
We have monitored these two populations regularly since the mid-1990s, including limited radio-tracking of a couple of individuals in the early 1990s. Both ponds are entirely within the fire perimeter and a mosaic of fire severity occurred in close proximity (<100 feet) to the pond perimeters. However, high severity fire was dominant within 0.5 mile of the edges of the ponds.

"Grandfather Pond" is a small (<0.1 acre), isolated wetland approximately three miles to the west of Mud Lake and lies just on the lip of the Tuolumne River canyon. A modest sized population (20 individuals) has been observed at this location. There are approximately 80 acres of upland habitat around the pond. Fire severity was high to the north of the pond as the fire climbed out of the canyon, but on the other sides of the pond, fire severity was low to moderate. Based on aerial imagery, this pond does not maintain perennial water in the driest years. During periods of drought, the turtles may extensively use the upland habitat for aestivation in addition to overwintering.

Abernathy Meadow lies immediately to the west of Grandfather Pond and has a seasonal wetland in the meadow. The meadow is approximately 4.5 acres in size and the flooded portion coincides well with the mapped area of the meadow. This wetland is filled by rain and snow and typically holds water until June or July. Once the standing water is gone, the turtles move into the upland to aestivate and generally towards the north. This may be due to the disturbance created by the road that runs south of the

meadow. Fire severity was mixed around the meadow with high severity conditions mapped to the south of the meadow and very low to low severity fire immediately north and east of the meadow. Upland habitat surrounding the ponds comprises approximately 132 acres.

"Grandfather Pond" is a small (0.1 acre) pond perched on the rim of the Tuolumne River canyon. It lies approximately 0.4 miles east of Abernathy Meadow and 1.5 miles west of Mud Lake. Burn severity patterns described for Abernathy Meadow were consistent around Grandfather Pond. There are approximately 80 acres of upland habitat surrounding the pond, and upland habitat here overlaps with that of Abernathy Meadow. Like Grandfather Pond, **Homestead Pond** is a small (0.1 acre) aquatic feature that lies immediately above the Tuolumne Canyon near Buck Meadows. There are approximately 90 acres of upland habitat. The fire affected upland habitat to the north and east of the pond, but some habitat was relatively unaffected.

Other streams providing suitable habitat for the WPT include those listed under the FYLF as providing suitable habitat. The following estimates of stream miles (and acres) providing suitable aquatic habitat for the WPT are estimated using best professional judgment which involved the use of aerial imagery, stream gradient maps, descriptions of habitat on survey forms, and visual estimates made during field visits. These creeks include all or portions of the following that are direct tributaries to the Tuolumne River: Cherry (11 miles of perennial stream habitat in the mainstem, 2,600 acres of upland habitat), Corral (5.5 miles, 1,300 acres), Grapevine (5 miles, 1,200 acres), Indian (2 miles, 480 acres), and Jawbone (11 miles, 2,600 acres). The following creeks are direct tributaries to the Clavey River: Bear Springs (1 mile, 240 acres), Bull Meadow (1 mile, 240 acres), Cottonwood (2 miles, 480 acres), Quilty (1 mile, 240 acres), and Reed (6 miles, 1,400 acres). The streams listed previously for the North Fork Merced River include most stream miles in that watershed that provide suitable aquatic habitat for the WPT.

The table below shows the streams, ponds, and meadow with known WPT populations and lists the primary streams that provide suitable habitat for the turtle.

Table 8. Streams occupied by and providing suitable habitat for the western pond turtle in the Rim Fire area, including stream miles, pond acreage, and acres of upland habitat

Watershed (5th level Hydrologic Unit Code)	Stream name	Occupancy (Yes/Unknown)	Survey (Yes/No)	Miles of suitable stream	Acres of upland habitat (300-foot buffer)
Tuolumne River	Tuolumne River	Yes	Yes	36.5	8711
	Drew Cr.	Yes	Yes	4.6	1011
	Grapevine Cr.	Yes	Yes	10.8	2565
	Jawbone Cr.	Unknown	Yes	14.3	3411
	Three unnamed ponds	Unknown	No	10 acres	277
	Homestead Pond	Yes	Yes	0.4 acre	91
	Middle Fork Tuolumne River	Yes	Yes	25.5	5365

Watershed (5th level Hydrologic Unit Code)	Stream name	Occupancy (Yes/Unknown)	Survey (Yes/No)	Miles of suitable stream	Acres of upland habitat (300-foot buffer)
Middle Fork Tuolumne River	Abernathy Meadow	Yes	Yes	7.5	132
	Grandfather Pond	Yes	Yes	0.2 acre	82
	Mud Lake	Yes	Yes	3 acres	115
North Fork Tuolumne River	North Fork Tuolumne River	Yes	Yes	75	16718
	Basin Cr.	Unknown	Yes	17.8	3902
	Hunter Cr.	Yes	Yes	21.5	4912
South Fork Tuolumne River	South Fork Tuolumne River	Yes	Yes	29.4	6411
Cherry Creek	Cherry Cr.	Unknown	No	17.8	3737
	Eleanor Cr.	Unknown	No	2.3	599
	Big Kibbie Pond	Yes	Yes	1 acre	98
	Little Kibbie Pond	Yes	Yes	0.5 acre	86
Clavey River	Clavey River	Yes	Yes	29	3460
	Reed Cr.	Unknown	Yes	4.2	904
North Fork Merced River	North Fork Merced River	Yes	Yes	74.4	16908
	Bull Cr.	Yes	Yes	44.7	9879
	Deer Lick Cr.	Unknown	Yes	9.7	2234
	Moore Cr.	Yes	Yes	11.9	2767
	Scott Cr.	Unknown	Yes	1.9	453

Fire Effects

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/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 National Forest. 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 from the Stanislaus 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 Creek and Granite Creek (Cherry Creek); and Hull, Reed (including Bourland, Reynolds, and Little Reynolds Creeks), and Twomile Creeks (Clavey River). Additionally, there are numerous very small, typically 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. There are some wetlands in fire perimeter that support obligate herbaceous riparian species as dominant plant community types.

Post-fire effects on aquatic and riparian habitats

Wildland fire can cause many dramatic effects to aquatic and riparian habitats. Those effects can occur in the short- and longer-term. Very short-term effects are incurred during, and immediately following, the passage of the advancing edge of the fire. Some examples of these very short-term effects include increases in water temperature, gases dissolved in water, and loss of riparian vegetation shading. Typically, these are classified as direct effects because they are immediately attributable to the fire. Short-term effects typically occur one to three years following the fire and some examples of these effects include increased delivery of sediment to streams, pulses of nutrients, and stream channel erosion. Long-term effects can be observed for many years or decades and examples include changes in streambank stability and stream shading. Very long-term impacts to riparian and aquatic systems can also be observed and an example is the reduced recruitment of very large woody debris, trees that take several hundred years to attain large sizes (>45 inches in diameter at breast height).

There is a considerable body of literature discussing post-fire effects, but the amount of literature pertaining to reptiles and amphibians is lacking, especially the species considered in this document. The available literature for fish (especially trout) and aquatic macroinvertebrates appears to be fairly well described, but a lesson learned is that different species may respond to fire in very different ways. For the amphibian and reptile species considered in this document, all have aquatic requirements for one or all life stages. These requirements include breeding activities, growth and development in larval forms, and foraging. All of the amphibian and reptile species also spend a considerable amount of time in terrestrial environments, sometimes long distances (>0.25 mile) from water.

Several journal articles were primarily used in developing this discussion of post-fire effects on aquatic and riparian systems and include Gresswell (1999) and several articles contained in the special issue of the journal Forest Ecology and Management (Young, et al. 2003) which was entirely devoted to the effects of wildland fire on aquatic ecosystems

in the western United States. These articles are summarized in the paragraphs that follow and statements made here may reflect the work of other authors, but were used to support the general discussions of the effects of fire on aquatic and riparian systems. The discussion that follows is intentionally brief, but is expected to provide the reader with an understanding of the ways fire can affect the habitats that aquatic species depend upon.

Many factors influence the degree of effect that any given fire may have on aquatic and riparian systems. Fire size and severity govern the extent and magnitude of post-fire related processes that influence these systems. Fire size is relatively obvious in that a very small fire (<10 acres) may have very localized (and small) effects on the landscape, but large fires (>50,000 acres) have the potential to dramatically affect large watershed areas, including multiple watersheds. Fire severity can be applied in several ways. Earlier in this document, high severity fire was used to describe the extent of vegetation mortality on the landscape, but, fire severity also applies to the extent to which heat is applied to the soil. The burn severity as related to vegetation may be important in describing effects to riparian shading while burn severity related to soils is very important when considering the potential for erosion to occur on hillslopes or water to runoff those hillslopes without soaking into the soil.

The **direct effects** of fire on aquatic and riparian systems are generally associated with the mortality of individuals, either plants or animals. Mortality of fish has been documented, but it is rare that all individuals are killed in a stream. Mortality is likely associated with very high fire intensity which causes water temperatures to exceed a tolerance threshold or changes in water chemistry via the assimilation of smoke and gases into the water. Mortality of vegetation is an obvious effect of a wildfire and is typically variable at patch and landscape scales, where “islands” of live vegetation can be found within large patches of high vegetation mortality. Vegetation mortality typically involves the loss of the above ground portion of the plant. Most obligate riparian species, those species requiring very close contact with water (also called phreatophytic), have evolved strategies to survive disturbances (like fire) by resprouting from root crowns, living stems, roots, and rhizomes; production of seeds light enough to be dispersed by wind and water; and production of refractory seeds which require the heat from fire or chemicals produced by burned vegetation to germinate.

The **indirect effects** associated with a fire may last for years or decades and influence watershed characteristics such as increased hillslope erosion and sedimentation of aquatic systems, stream channel erosion, changes in patterns of stream water discharge, nutrient pulses and changes in productivity, reduced stream shading, increases in stream temperatures, and alteration of large woody debris dynamics. Observations made during 2015 indicated that many areas are experiencing a robust vegetation response, mostly comprised of shrub growth. This recovery is likely to substantially reduce impacts (e.g., sediment input) to aquatic habitat over the next few years, though pre-fire conditions in may not return for a decade or more, particularly in areas of high burn severity.

Erosion and sedimentation: Surface or hillslope erosion is influenced by a complex interaction of soil/geology, topography (steepness of a hillslope), vegetation, and climate.

Post-fire, increases in erosion and subsequent sedimentation of aquatic habitats are primarily influenced by soil burn severity, steepness of hillslope, amount of ground cover remaining, and the intensity/duration of precipitation events, typically rain. The building blocks for very high erosion rates would include extensive areas of high and moderate soil burn severity, very little to no ground cover, steep hillslopes, and a period of rainfall with high intensity. High and moderate soil burn severity physically alters the structure of soil, making it easier to detach individual soil particles (more prone to erosion). These burn severity conditions also increase the hydrophobicity, or water repellency, of the soil which decreases (or even inhibits) the rate at which precipitation will soak into the ground. Ground cover in the form of organic matter (live vegetation, leaf litter) helps to protect the soil from erosion by limiting the detachment potential for individual soil particles. Very little or no ground cover means the soil can be mobilized easily during precipitation events and transported downslope by water flowing across the soil surface. On gentle slopes (<15%), eroded soil is not easily transported, but, as slope steepness increases, less energy is required keep soil in transport downslope. Finally, the intensity or duration of a precipitation event plays a critical role in the potential for water to flow across the soil surface and is directly related to the infiltration capacity of the soil. High intensity rainfall events produce large quantities of rain in a short period of time. Under this condition, the soil cannot soak in the rain at a rate equivalent to the rainfall intensity and water begins to flow across the soil surface, eroding the soil particles at the same time. Similarly, long duration precipitation events (or melting snow) can saturate the soil which initiates overland flow and erosion. All other things being equal, precipitation intensity may be the one factor that truly drives extreme erosion.

Increased sediment delivery (compared to unburned conditions) can persist for years following a wildfire. In the first year following a fire, erosion rates are typically the highest and can be several orders of magnitude greater than erosion rates in unburned forests. These post-fire rates typically decrease rapidly after the first precipitation year on a fire. In this part of the Sierra Nevada, hydrophobic conditions caused by high fire severity typically only last one to three years and are attributable to a variety of physical and biological processes. As such, infiltration rates in severely burned areas rapidly return to pre-burn levels. Ground cover typically increases rapidly with the establishment of herbaceous species and the regrowth by stump sprouting shrub species. When increased infiltration rates and ground cover are combined, the proportion of the landscape vulnerable to erosion quickly decreases.

It should be noted that areas affected by very low to low fire severity classes typically do not respond with large increases in erosion. This is because the soil structure is maintained, hydrophobic conditions do not form, and ground cover is maintained either through existing live vegetation or the addition of leaves and needles killed by the fire. Therefore, the proportion of burn severities observed within a watershed regulate erosion and sediment delivery to streams, with greater proportions of high severity fire producing much more sediment than more lightly burned watersheds.

Landslides (mass wasting) and debris flows are two extreme types of erosional processes that can deliver very large volumes of sediment to aquatic systems following an extreme

fire. Debris flows, also called mudslides, are shallow landslides that are saturated with water. This erosional process can transport large volumes of sediment and wood and really scour a stream channel by eroding the vulnerable streambanks. Landslides tend to be more deeply rooted and typically involve higher sediment volumes than debris flows, and are also triggered by soil saturation. While landslides can occur immediately following a fire, they tend to occur many (4-10) years after burning when tree roots decay and the cohesive strength of the soil is decreased.

The increased overland and stream flows and transport of sediment and large woody debris in stream channels that occurs in the post-fire environment may also impact the **road system** within and downstream of the fire area. Forest roads are the source of significant sediment for many streams because a majority of roads have a native (dirt) surface, which is easily eroded. The lack of routine road surface maintenance, construction of ineffective drainage structures (examples, culverts and rolling dips), and continued use and maintenance of inside ditches (versus outsloping the road) all combine to produce excess sediment in unburned conditions, but especially in post-fire areas where runoff increases are anticipated. Roads and their associated drainage features (ditches and rolling dips/waterbars) tend to concentrate water flowing across and down the road surface. When the concentrated flow is delivered to a stream or a severely burned slope, stream channel and gully erosion can be initiated or aggravated. Rolling dips and waterbars are typically installed assuming an unburned watershed condition and, as such, their spacing tends to be too great to effectively dissipate post-fire runoff. The wider spacing allows the water to gather energy as it flows down the road surface, and the diversion can gully the receiving hillslope as previously mentioned.

Also, many existing stream crossings were not designed to facilitate the passage of increased post-fire water and fire-generated debris, resulting in road failures, overtopping of culverted crossings, and diversion of flow down roads. When road crossings fail, large volumes of earthen fill typically get eroded and washed down the stream that is being crossed. Undersized culverts can become plugged by woody debris and sediment, causing the water to overtop the road prism and erode the road surface and downhill slope of the crossing.

Channel erosion and sediment deposition: In the wake of a wildfire, stream channels are frequently altered by increases in streamflow and sediment supply. During post-fire runoff events, more water is routed to stream channels because absorptive leaf litter layers have been reduced or eliminated, higher severity soil burn conditions tend to encourage overland flow, and evapotranspiration by living vegetation is reduced. Increased streamflows, especially those induced by very large storms (>25 recurrence interval), can erode stream channels in three dimensions: vertically, laterally and longitudinally. With the extensive loss of vegetation on the landscape, many stream channels are vulnerable to erosion and can incise deeper than the existing channel. This type of erosion is most pronounced in streams that are in alluvial deposits and less pronounced in bedrock and boulder/cobble streams. Moody and Martin (2001) describe channel erosion as the dominant source of post-fire sediment with hillslope erosion accounting for a minor fraction of sediment transported by stream channels in the post-

fire environment. Lateral erosion can occur when greater streamflows force the water wider in a channel, thereby eroding existing streambanks. Increases in streamflow can also induce streambed scour in intermittent and ephemeral channels, extending all the way up to the top of the watershed boundary.

The fate of the sediment produced by in-channel and hillslope erosion is determined by the morphology and physical characteristics of the stream. The physical characteristics of the stream (examples: gradient, substrate composition) determine whether the sediment is transported out of the system or stored in areas such as low gradient reaches, behind debris dams, or on floodplains. In general, the sediment delivered to streams following the first sediment-producing flows is retained in-channel which results in channel aggradation (the level of the streambed rises). Using the Bagley Fire (Shasta Trinity National Forest in 2012) as an example, the following observations were made in streams in the fire area following two large storm events: low gradient (<2%) streams aggraded approximately 1.5 feet on average and exceeding three feet in some areas; substrate size decreased as a result of sand and gravel accumulation in the channels; and a significant loss of slow water habitats (pools and glides) via inundation by sediment (USDA 2013). During subsequent runoff events and years, streamflows tend to flush fine sediments downstream and redistribute larger sized sediments throughout the channel. Higher gradient sections of stream generally tend to transport sediment out of them and lower gradient sections of stream generally tend to store sediment in them.

Wildfires can cause changes in stream channels and commonly induce those changes one to four years following the fire. Some impacts to channels, such as reduced streambank stability, may take a decade or longer to stabilize and function more closely to pre-fire conditions. It should be noted that, while the temporary condition of an inundated channel may appear “devastating” or “catastrophic” to a stream, all stream systems require temporary pulses of resources (including sediment) to create and maintain micro- and macro-habitat types in a stream network. The changes in habitat that can be observed in the post-fire environment may favor some species in the short- and/or long-term, and may be detrimental to other species.

Debris flows are a type of mass wasting that occurs in a stream channel and combines stream flow with large volumes of eroded sediment or sediment generated by debris slides. As this mass of liquefied mud moves down the channel, it begins to entrain additional sediment that is eroded from the stream’s channel and banks. Large woody debris is also mobilized by debris slides and flows. If the channel gradient is high enough, the debris flow can travel long distances and increase in mass to a point where it causes extensive changes in channel morphology. The energy of debris flows can dissipate in low gradient channels and deposit very large volumes of sediment in these reaches. Or, the flows can continue downstream and terminate at the confluence of a larger stream. Some of this sediment is stored on floodplains and can remain intact for decades to centuries. The sediment that resides in the channel is transported downstream in subsequent years, potentially influencing channel substrate composition and instream habitat complexity for many years (10+ years).

Water discharge: As noted previously, the loss of vegetation from the landscape following a fire can reduce infiltration capacity which leads to atypical runoff patterns (peak streamflow) when compared to pre-fire conditions. The baseflow of a stream can also increase in the post-fire environment if sufficient vegetation mortality occurs in the watershed. This increase in baseflow can cause dry streams to resurface, intermittent streams to sustain perennial flow, and perennial streams to yield a greater quantity of water over the course of a year. The increased magnitude of peak flows and baseflow are important factors for transporting post-fire sediments that are stored in channels. These changes are also important in mobilizing and redistributing stream substrates throughout a stream system.

Nutrient pulses and stream productivity: Wildfires produce an immediate change in water chemistry during and immediately following the passage of the fire front, lasting days or several weeks. As noted earlier, gases produced during the combustion of vegetation can be assimilated into stream water. The main nutrient input from gases is nitrogen and is associated with ammonium in gaseous form. Another well documented change in water chemistry is an increase in phosphorus, attributable to leaching of aerially deposited ash.

During post-fire precipitation events that deliver sediment to streams, increases in phosphorus have been reported when ash is mobilized to the channel and chemicals are leached from the ash. This punctuated delivery of sediment results in peaks or pulses of nutrient reaching the stream that typically last a year or two. In slightly longer timeframes (2-5 years), changes in water chemistry have been observed and associated with altered nutrient cycling resulting from the loss of forested cover. Seasonal peak increases for these prolonged changes in water chemistry were associated with spring run-off.

In the naturally occurring nutrient-poor state of streams (attributable to underlying geology) in the Sierra Nevada, these nutrients can be quickly taken up by plants (algae). When combined with increased sunlight reaching the stream (discussed below), the addition of readily usable nutrients can temporarily (five or so years) enhance primary productivity of many streams. Increases in primary productivity can initiate trophic cascading effects whereby secondary productivity (mainly aquatic benthic macroinvertebrates (insects)) is also stimulated. This type of trophic cascade may extend to larger aquatic and aquatic/terrestrial food webs, providing more food resources to fish, stream associated amphibians, and riparian bird and bat specialists.

Stream shading and water temperature: Obviously, when moderate and high vegetation severity fire burns through a riparian area (and adjacent hillslopes), stream shading can decrease as tree mortality increases. Once the vegetation loses the dead needles or leaves, the bole and branches provide very little shade. The decrease in shade and live riparian vegetation can lead to warmer stream temperatures through an increase in direct sunlight hitting the water and impairment of the cooler riparian microclimate. An impaired riparian microclimate means the vegetation no longer has the capacity to

restrict air flow along the stream corridor and drier, warmer conditions at the stream surface further promote water warming.

This shading concept applies mainly where there is a forested overstory, but at a much smaller scale, the fire can also temporarily eliminate the shading provided by herbaceous vegetation, typically tall sedges growing along the stream margin. As noted earlier, many of these sedge species are adapted to disturbance and can quickly regrow the leaves, even initiating new growth in as little time as a few days post-fire.

The loss of stream shading can mean that some streams, typically small streams (1-3 feet wide or headwaters (1st and 2nd order), can see water temperature increases of ten or more degrees (Fahrenheit) for a couple of years post-fire. Temperature increases may be partially offset by increased streamflow from enhanced groundwater interaction. The duration of reduced stream shading largely depends on the pre-fire extent of obligate riparian species. Local observations on Rose and McCormick Creeks indicate obligate riparian species can provide very high levels of stream shading (>60%) within ten years of the disturbance. The recovery of this riparian vegetation is certainly promoted when livestock grazing is excluded as evidenced by exclosures constructed on the upper section of Rose Creek. Outside of these exclosures, heavy grazing on resprouting willows and alders has retarded the development of shade providing vegetation.

In general, the extent to which a stream experiences decreased stream shading and commensurate increases in water temperatures depends upon the extent of vegetation killing fire in relation to the stream's length or watershed area. If a fire induces mortality for >50% of the shade producing vegetation, an increase in stream temperatures is likely to occur. Conversely, temperature increases are not expected if <25 % of the shading is lost or low severity fire occurs within the riparian area (Arkle and Pilliod 2010).

Large woody debris: Wildfires can reduce the volume of large woody debris (LWD) stored in stream channels or on floodplains if the fuel moistures in the wood are relatively low. This occurred in at least one stream, Reed Creek, during the Rim Fire and likely occurred in other streams with greater proportions of high severity fire. During and immediately following the fire, there can be recruitment of LWD as snags burn at the ground or previously fire-damaged trees fail. If high vegetation severity fire occurs extensively along a stream, then large inputs of LWD are possible over the next several decades as the trees are structurally weakened and fall. The long-term consequence of extensive high severity fire in the riparian area is that there may be a long interval to the next time LWD can be recruited to the stream, especially where older growth forest is lost. In this case, it can take centuries to grow a 60-80 inch Douglas fir that is the next beneficial piece of LWD. Other events, such as large landslides or severe wind events, can cause large numbers (and volume) of LWD to be recruited to streams and riparian areas. Post-fire erosional processes can also transport large volumes of pre- and post-fire LWD during floods in severely altered watersheds.

Large woody debris plays an important role in stream morphology and adding habitat complexity. When LWD is lodged in a stream channel, either as individual pieces or

aggregations, it can reduce water velocity and cause sediment to be deposited upstream of the wood (the channel aggrades). This sediment can be stored for many decades and gets redistributed over long time periods when the woody obstruction fails. Downstream of LWD obstructions, pools often form as the streambed is scoured by the energy of falling water. So, beneficial habitats are formed upstream (example, spawning beds for fish) and downstream (deep pool with overhead cover) of the LWD.

Expectations for the watersheds affected by the Rim Fire

Several sources of information were used in predicting the extent to which we expect changes in aquatic and riparian systems. First, patterns and extent of fire severity, both vegetation and soil, were examined using aerial imagery and fire severity mapping. Watersheds with a high proportion of moderate and high severity fire were singled out for having a high potential to see significant changes in post-fire erosional processes, including erosion rates, sedimentation, and discharge. Then, the fire patterns within these watersheds were evaluated, especially as related to proximity to the streams. Data generated by the 1) Rim Fire Burned Area Emergency Response reports and 2) specialist reports for this EIS were incorporated. The primary sources used to develop expectations for watershed response included the soils, hydrology, and geology. The soils reports (BAER and Rim Reforestation Project) detail erosion and sedimentation, the hydrology reports (BAER and Rim Reforestation Project) detail changes in stream discharge and channel response, and the geology report (BAER) details the potential for landslides. All of this available information was used to develop specific expectations for the suitable and occupied habitats for the species considered in this document. Table 9 displays the anticipated changes in stream flow and sediment delivered to the stream channel at the most downstream point in the watershed.

Table 9. Changes in streamflow and sediment yield to channel for selected streams providing suitable habitat for aquatic species in the area affected by the Rim Fire.

5th Level HUC Watersheds	6th Level HUC Watersheds	Streams	Pre-fire stream flow (in cubic ft/second)[1, 2]	Post-fire stream flow (in cubic ft/second)[1,2]	Sediment Yield[3] (in tons)
North Fork Merced River	Upper N. Fk. Merced R.	N. Fk. Merced R.	237	237	9,805
		Deer Lick Cr.	n/c	n/c	1,955
		Moore Cr.	n/c	n/c	3,223
		Scott Cr.	n/c	n/c	1,250
	Bull Cr.	Bull Cr.	331	356	2,586
Cherry Cr.	Kibbie Cr.	Kibbie Cr.	175	214	1,311
	Miguel-Eleanor Cr.	Eleanor Cr.	825	1,214	13,709
	Lower Cherry Cr.	Cherry Cr.	1,891	3,038	56,494
		Granite Cr.			14,843
Tuolumne River – Big Creek	Hetch Hetchy-Tuolumne R.	Tuolumne River	3,457	3,486	n/c
	Poopenaut Valley-Tuolumne R.	Tuolumne River	3,707	4,311	24,659
	Jawbone Cr.-Tuolumne R.	Tuolumne R.	5,505	8,216	99,846
		Alder Cr.	n/c	n/c	5,312

5th Level HUC Watersheds	6th Level HUC Watersheds	Streams	Pre-fire stream flow (in cubic ft/second)[1, 2]	Post-fire stream flow (in cubic ft/second)[1,2]	Sediment Yield[3] (in tons)
		Corral Cr.	n/c	n/c	21,417
		Drew Cr.	n/c	n/c	4,420
		Jawbone Cr.	n/c	n/c	40,058
	Grapevine Cr.-Tuolumne R.	Tuolumne R.	8,849	14,435	43,752
		Grapevine Cr.	n/c	n/c	12,587
Middle Fork Tuolumne River	Upper M. Fk. Tuolumne R.	M. Fk. Tuolumne R.	404	849	22,263
	Lower M. Fk. Tuolumne R.	M. Fk. Tuolumne R.	603	1,600	43,073
South Fork Tuolumne River	Upper S. Fk. Tuolumne R.	S. Fk. Tuolumne R.	558	1,161	29,060
		Ackerson Cr.	n/c	n/c	9,907
	Lower S. Fk. Tuolumne R.	S. Fk. Tuolumne R.	1,317	3,421	62,180
Clavey River	Reed Cr.	Reed Cr.	397	821	29,256
	Lower Clavey R.	Clavey R.	1,350	2,502	51,831
		Adams Gulch	n/c	n/c	2,341
		Bear Springs Cr.	n/c	n/c	7,287
		Bull Meadow Cr.	n/c	n/c	3,016
		Indian Springs Cr.	n/c	n/c	1,239
		Quilty Cr.	n/c	n/c	3,462
		Unnamed Tributary 1	n/c	n/c	2,908
		Unnamed Tributary 2	n/c	n/c	1,579
		Unnamed Tributary 3	n/c	n/c	5,115
		Unnamed Tributary 4	n/c	n/c	1,099
		Unnamed Tributary 5	n/c	n/c	2,073
	Mid. Clavey R.	Clavey R.	819	1,076	26,880
		Cottonwood Cr.	n/c	n/c	7,972
		Russell Cr.	n/c	n/c	935
North Fork Tuolumne River	Lower N. Fk. Tuolumne R.	N. Fk. Tuolumne River	891	1,026	16,060
		Basin Cr.	n/c	n/c	807
		Hunter Cr.	n/c	n/c	15,205

n/c = not calculated, [1]Values from the Rim Fire BAER hydrology report. [2]Values are not additive for the stream segments lying upstream. [3]Assumes all sediment eroded from hillslope is routed to the channel and transported to the most downstream point in the watershed.

For the foothill yellow-legged frog, the impact to aquatic habitat is based on expected post-fire watershed response at various watershed scales. The estimates rely on 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. In the Watershed Report prepared for the Rim Reforestation EIS, the Existing Watershed Condition provides a general narrative for how the primary watersheds (5th and 6th level HUC) are expected to respond in the post-fire

environment, 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. 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. In high concern watersheds, we expect major impacts to all habitat types, especially significant reduction of pool and other deep water habitat. Deep water habitats are refuges and critical to overwintering success and escape from perceived predation attempts. In moderate concern habitats, extensive sedimentation of all habitats is expected, but deep water habitats should be maintained by the scouring action of water. Table 10 lists the watersheds suitable for FYLF and expected level of watershed response.

Table 10. Watersheds providing suitable foothill yellow-legged frog habitat and the expected level of post-fire watershed response.

HUC level and name	Stream name	Level of post-fire watershed response (low, moderate, high)
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	Eleanor Creek	Moderate
5 – Falls Creek-Tuolumne River	Tuolumne River	Low
5 – Middle Fork Tuolumne River	Middle Fork Tuolumne River	Moderate
5 – South Fork Tuolumne River	South Fork Tuolumne River	Moderate
5 – North Fork Merced River	North Fork Merced, Bull, Deer Lick, Moore Creek, Scott	Low

For the WPT, the potential for impact to aquatic habitat is also associated with the level of watershed response shown in Table 10. Since the WPT occurs with the FYLF in many streams and the two species use many of the same aquatic habitat types (especially deep

water runs and pools), the evaluation made for the FYLF is considered to be appropriate for the WPT. The expected level of watershed response to suitable pond habitat is low for all ponds. The reason the concern is low is because the hillslopes adjacent to all of the ponds is relatively low and sediment should not transport across these gentle slopes. The only exception to this includes two of the "ponds" on the South Fork Tuolumne River that are actually impounded stream segments created by a dam on private property. These two habitats will see a moderate change that is commensurate with the evaluation for the river at the 5th level HUC scale.

For the hardhead, suitable habitats in the Clavey River, North Fork Tuolumne River, and Tuolumne River are not expected to be extensively altered by post-fire watershed response. In these three rivers, the large pool and deep run habitats are likely to be maintained by periods of peak streamflow.

EFFECTS OF THE PROPOSED PROJECT

Effects Analysis Methodology

Assumptions Specific to Aquatic Species

For the foothill yellow-legged frog (FYLF) and western pond turtle (WPT), we assumed 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 (example, 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) 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.

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 percent sediment routing to stream channels is an overestimation. However, using this assumption allows for the comparison of erosion rates and sedimentation across all alternatives.

Regardless of the level of project-related activity, 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 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 impair biological functions. Further, there would be very little detectable change in 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.

Water quality best management practices (BMPs) and management requirements that are intended to minimize sedimentation are assumed to be implemented and implemented effectively.

Data Sources

Most of the data sources used are corporate spatial data layers (used in ArcMap 10.1), data generated during the post-fire evaluation period (Burned Area Emergency Response (BAER) reports), or were generated during the planning process for the EIS. The corporate layers include the Stanislaus National Forest basemap, watersheds delineated at multiple scales (Hydrologic Unit Codes 5-8), stream gradient layer, the Stanislaus National Forest aquatic survey database (Aquasurv), and the California Natural Diversity Database. The data sources used from the planning process include erosion and sediment modeling, and project-related activities by action each alternative. The hydrology, soils, and geology BAER reports for the Rim Fire stated anticipated changes in stream runoff and hillslope erosion, and the potential for debris flows and landslides to occur.

Aquatic Species Indicators

The indicators used for the analysis of potential impacts to aquatic species include the amount of species-specific buffer affected by the activities in each alternative and proportion of watershed affected by project activities. Specific indicators are:

- percentage of CRLF aquatic breeding, non-aquatic breeding, and upland habitat affected by project activities
- percentage of SNYLF buffer affected by project activities
- 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, and
- qualitative estimate of FYLF and WPT watersheds affected by project activities.

Aquatic Species Methodology by Action

For CRLF, areas were identified as suitable for the species if they occurred at or below 4,000 feet in elevation and contained breeding habitat identified as streams with 1) low gradient (<4%), 2) presence of pools holding water for 20 weeks during timing of egg and tadpole development, 3) absence of high stream flow during the breeding period which could wash egg masses or tadpoles downstream or ponds large and deep enough to hold water for 20 weeks during egg and tadpole development. Non-breeding aquatic habitat was identified as any water bodies within 1 mile of potentially suitable breeding habitat, while upland habitat consists of terrestrial areas within 1 mile of suitable breeding habitat. Dispersal habitat includes any upland, riparian, or aquatic habitat accessible and contiguous between suitable breeding habitats, within 1 mile of each other.

For CRLF the spatial extent of the cumulative effects analysis occurred at the extent of the suitable upland habitat (one mile from breeding habitat), and the extent of the watersheds to determine potential sediment input.

For the FYLF and WPT, all streams below 4,200 feet were identified as suitable for the species. For the FYLF, all of these stream miles were buffered by approximately 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 of the stream 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 action alternatives were placed over the upland areas, or an intersection was created, to estimate the amount of area impacted by each activity for each species.

The temporal boundary established for all species for cumulative effects analysis was ten years from present, a date commensurate with the Cumulative Watershed Effects (CWE) modeling completed for the project (see Watershed Report). The reason this time frame was chosen is related to the modeling approach using a threshold of concern (TOC) for watersheds. When a watershed exceeds the TOC, there is an increased risk that a variety of watershed processes may not occur as they would when a watershed functions below the threshold. An example of a watershed process that may not function normally when the TOC is exceeded is the stability of the stream within its channel. When the TOC is exceeded there is the risk that the streambanks will become unstable and bank erosion can occur. This can lead to increased sedimentation in the channel, reduction in deep water habitat volume, reduction in interstitial spaces in the streambed, higher 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 model includes recovery times for certain actions, like logging, or events, like wildfire, whose effects diminish over time. When a watershed returns below a TOC, natural processes in the stream system are expected to dominate and the stream should regain a high degree of stability over time. The CWE

modeling indicated all streams (at 6th and 7th level HUC scale) would recover to near pre-fire levels within this time frame. It should be noted that some elements of the cumulative effect analysis, such as the long term recruitment of large woody debris, may extend 100 or more years into the future, but this timeframe could not be applied in the context of reasonably foreseeable future.

The analysis of effects for this project was exceptionally difficult due to the uncertainties about the precipitation patterns the first several years following the fire. Exceptionally wet or intense winter storms, especially rainfall dominated storms, can result in extreme runoff, streamflow, sediment delivery, and modification of aquatic and riparian habitats. As of the date on this document (December 2015), precipitation was considerably below average for the water years 2013-2014 and 2014-2015. This lack of rain also affected the "spring green up" period, a time when the seed bank germinates and re-sprouting vegetation emerges. The precipitation year is likely to be classified as a "critically dry" year. This suggests that soil moisture may not be maintained long enough to support the extensive establishment of new vegetation, especially in areas affected by high soil burn severity. As such, the extent of ground cover in the two post-fire growing seasons may be less than expected, if we were to expect a "normal" or average precipitation years. Even with the dry winters, field observations in 2015 identified that extensive shrub growth has occurred in many areas in the two post-fire growing seasons.

Because ground cover is an important factor in post-fire erosion rates, the low ground cover conditions that are likely over the next few years may not be adequate to naturally mitigate erosion rates. At this point in time, it is impossible to determine what the 2015-2016 precipitation year will be and post-fire watershed responses may be higher next year than they were in 2013-2014 or 2014-2015. Therefore, there is a degree of uncertainty in watershed response and assumptions about vegetative recovery and ground cover made in the analyses that this report relies upon (watershed and soils) may not be completely accurate.

Aquatic species effects

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 (Chapters 3.11 and 3.15 of EIS). The table below displays results from sediment modeling (Watershed Erosion Prediction Program) in select areas where treatment is proposed adjacent to special status species habitat. These sites represent areas that are expected to receive higher intensity treatment (e.g., deep tilling); therefore, most project units are expected to produce less sediment than those displayed in the table. As compared to sediment mobilization in high severity fire areas, the values below are substantially lower (e.g., an order of magnitude less). The project hydrology and soils reports provide additional details on sediment mobilization magnitude and timing.

Table 11. Sediment modeling results for units near special status species habitat.

Species suitable habitat*	Unit/site	Sediment (tons/acre)			
		Deep- tilling 2-year return interval	Deep- tilling 10-year return interval	Deep- tilling **average annual**	No treatment (control) **average annual**

SNYLF	N019/1	0	.720	.151	.009
SNYLF	CC001/2	.163	.703	.267	.018
CRLF	X028	0	.165	.049	.022
CRLF	V012	.607	1.486	.641	.076
FYLF/WPT	T009	1.232	2.733	1.331	.659
FYLF/WPT	R046/038	1.6726	3.105	1.455	.623

*SNYLF = Sierra Nevada yellow-legged frog; CRLF = California red-legged frog; FYLF = foothill yellow-legged frog; WPT = western pond turtle.

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 (Chapters 3.11 and 3.15 of EIS). 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 reduction in shade that can result in increased water temperatures; 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 (Federal Register 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 (Chapter 2.02 of EIS).

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. 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 (Chapter 2.02); 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 invasives, 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 12. CRLF and SNYLF Direct and Indirect Effect Indicators for Each

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. Percents represent the percent of 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, 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 (Chapter 2) 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 13. 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

Sub-watershed (HUC 7)	FYLF[1] Treated	REF/THIN[2] (acres)	WEED[3] (acres)
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 detrimental 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 14. Alternative 1: Buffer Treatment in WPT Suitable Habitat

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

General effects within project area

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. See Appendix B of the project EIS for further details.

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 15. Other actions within the project area.

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**	

Project/Activity	Action	Acres[1]	Acres[2]	Miles[1]	Miles[2]	QTY[1]	QTY[2]	Decision (year)
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 16. Reasonably foreseeable future actions within project area.

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.

Cumulative Effects for Federally Listed Species

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 (7th 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 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. Where livestock graze 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 would minimally 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 (3-10 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.

Cumulative Effects for U.S. Forest Service Sensitive Species

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. Stream flows 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 Chapter 2.02 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 becaus 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.

Compliance with the Forest Plan and Other Direction

1. Provide habitat for viable populations of all native and desired non-native wildlife, fish and plants and give special attention to sensitive species to see that they do not become Federally listed as Threatened or Endangered: Habitat suitability would be reduced in some watersheds for up to five years. During this time period, reproductive recruitment into existing populations could decrease slightly, but suitable habitat should be maintained over the long-term.
2. Maintain habitat connectivity for aquatic and riparian species: None of the project activities would create physical or biological barriers to up- or downstream movement of aquatic species.
3. Maintain streamflow patterns and sediment regimes in accordance with evolutionary processes: Streamflow will naturally increase in many streams in the post-fire environment; project activities are not expected to measurable effect flow. Heavy equipment use and prescribed fire could lead to small increases in sediment over the short-term (few years), but full stabilization would be expected to occur within a few years post-project. Analysis species are not known to be sensitive to small sediment increases.
1. Maintain high water quality values: Water quality best management practices and management requirements would be implemented and monitored in accordance with applicable direction.
2. In areas adjacent to waters with known populations of western pond turtle, construct new roads or trails or use existing off-road routes for motorized vehicles only if at least ¼ mile from occupied habitat or approved by a wildlife biologist: No new roads are proposed within ¼ mile of occupied habitat.
3. Ensure that management activities do not adversely affect water temperatures necessary for local aquatic- and riparian-dependent species assemblages: Equipment exclusion zones near streams would allow the re-establishment of obligate riparian species and existing riparian vegetation would not be measurably altered.
4. Limit pesticide applications to cases where project level analysis indicates that pesticide applications are consistent with riparian conservation objectives: Water quality best management practices and management requirements would align pesticide applications with RCOs. No application to water bodies is proposed.
5. Within 500 feet of known occupied sites for the California red-legged frog and foothill yellow-legged frog, design pesticide applications to avoid adverse effects to individuals and their habitats: Water quality best management practices and standards and guidelines limit pesticide use within RCAs. Risk assessments indicate very little risk to individual frogs at expected pesticide concentrations. Indirect effects are expected to be spatially isolated and short-term.
6. Prohibit storage of fuels and other toxic materials within RCAs and CARs: A management requirement to this effect is included for all action alternatives.
7. Ensure that culverts or other stream crossings do not create barriers to upstream or downstream passage for aquatic-dependent species: Project is not expected to affect aquatic organism passage.
8. Prevent disturbance to streambanks and natural lake and pond shorelines caused by resource activities from exceeding 20 percent of stream reach or 20 percent of

natural lake and pond shorelines: Management requirements would restrict the operation of equipment close to streams and prevent streambank disturbance.

9. Determine if the level of coarse large woody debris (CWD) is within the range of natural variability in terms of frequency and distribution and is sufficient to sustain stream channel physical complexity and stability. Ensure proposed management activities move conditions toward the range of natural variability: project would not measurably affect existing LWD, long-term growth and subsequent recruitment would likely be increased by action alternatives.
10. Use screening devices for water drafting pumps: A management requirement addresses this concern by requiring a drafting box (2 feet per side) covered in ¼ inch mesh at a minimum.
11. Post-wildfire management activities in RCAs and CARs should emphasize enhancing native vegetation cover, stabilizing channels by non-structural means, minimizing adverse effects from the existing road network, and carrying out activities identified in landscape analyses. Post-wildfire operations shall minimize the exposure of bare soil: Implementation of water quality best management practices would reduce long term sediment delivery from most treatment units. Existing riparian vegetation would be left intact, allowing for natural recovery of stream channel/bank stability.

Riparian Conservation Objectives

- RCO 1: Ensure that identified beneficial uses for the water body are adequately protected. Identify the specific beneficial uses for the project area, water quality goals from the Regional Basin Plan, and the manner in which the standards and guidelines will protect the beneficial uses: Addressed in project Watershed Report.

- RCO 2: Maintain or restore: (1) the geomorphic and biological characteristics of special aquatic features, including lakes, meadows, bogs, fens, wetlands, vernal pools, springs; (2) streams, including in stream flows; and (3) hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species: Project would minimally affect aquatic features, with no negative long-term effects anticipated. An increase in native vegetation distribution and growth rate is expected to occur under the action alternatives.

- RCO 3: Ensure a renewable supply of large down logs that: (1) can reach the stream channel and (2) provide suitable habitat within and adjacent to the RCA: Project is not expected to affect large down logs, and could lead to a long-term increase in recruitment due to faster tree growth as compared to the no action alternative.

- RCO 4: Ensure that management activities, including fuels reduction actions, within RCAs and CARs enhance or maintain physical and biological characteristics associated with aquatic- and riparian-dependent species: CARs are not present in the analysis area. RCAs would be minimally impacted, though short-term habitat effects are expected in some areas. A short-term decrease in vegetative cover and a small increase in sediment are possible along a minority of stream reaches. Long-term benefit is expected due to an increase in native vegetation distribution/growth within RCAs, and a related increase in bank/slope stability.

- RCO 5: Preserve, restore, or enhance special aquatic features, such as meadows, lakes, ponds, bogs, fens, and wetlands, to provide the ecological conditions and processes needed to recover or enhance the viability of species that rely on these areas: Special aquatic features would be minimally impacted, though short-term habitat effects are expected in some areas. A short-term decrease in vegetative cover and a small increase in sediment are possible along a minority of stream reaches. Long-term benefit is expected due to an increase in native vegetation distribution/growth within RCAs, and a related increase in bank/slope stability.
- RCO 6: Identify and implement restoration actions to maintain, restore or enhance water quality and maintain, restore, or enhance habitat for riparian and aquatic species: Same as above, long-term benefit expected due to an increase in native vegetation distribution/growth, and a related increase in bank/slope stability.

Effects Determinations

Because the project area lies outside the geographic and/or elevational range of the species, it is my determination that the Rim Fire Reforestation Project will not affect the limestone salamander or Yosemite toad.

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 lifestages would be maintained in the lower North Fork Tuolumne and Clavey Rivers and habitat for adult and sub-adult lifestages 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.

REFERENCES

Arkle, R. S. and D. S. Pilliod. 2010. Prescribed fire as an ecological surrogate for wildfires: A stream and riparian perspective. Forest Ecology and Management 259:893-903.

Barry, S. J., and G. M. Fellers. 2013. History and status of the California red-legged frog (*Rana draytonii*) in the Sierra Nevada, California, USA. Herpetological Conservation and Biology 8(2):456-502.

Bobzien, S. and J. E. DiDonato. 2007. The status of the California tiger salamander (*Ambystoma californiense*), California red-legged frog (*Rana aurora draytonii*), foothill yellow-legged frog (*Rana boylii*), and other aquatic herpetofauna in the East Bay Regional Park District, California. Oakland, California. 87p.

Boyer, D. R. 1965. Ecology of the basking habit in turtles. Ecology 46(1-2):99-118.

Bradford, D.F., F. Tabatabai, and D.M. Graber. 1993.Isolation of remaining populations of the native frog, *Rana muscosa*, by introduced fishes in Sequoia and Kings Canyon National Parks, California. Conservation Biology 7:882-888.

Federal Register. 1996. Endangered and threatened wildlife and plants; determination of threatened status for the California red-legged frog. Federal Register, volume 61, number 101, pages 25813-25833.

Federal Register. 2006. Endangered and threatened wildlife and plants; designation of critical habitat for the California red-legged frog, and special rule exemption associated with final listing for existing routine ranching activities. Federal Register, volume 71, number 71, pages 19244-19346.

Federal Register. 2010. Endangered and threatened wildlife and plants; revised designation of critical habitat for the California red-legged frog; final rule. Federal Register, volume 75, number 51, pages 12815 – 12959.

Federal Register. 2013a. Endangered and threatened wildlife and plants; endangered status for the Sierra Nevada yellow-legged frog, and the northern distinct population segment of the mountain yellow-legged frog, and threatened status for the Yosemite toad; proposed rule. Federal Register, volume 78, number 80, pages 24472 - 24514.

Fellers, G. M. 2005. California red-legged frog species account, *in* Amphibian declines: the conservation status of United States species, Michael Lannoo, ed. University of California Press, Berkeley, CA. 1094p.

Fellers, G. M. and K. L. Freel. 1995. A standardized protocol for surveying aquatic amphibians. Technical Report NPS/WRUC/NRTR-95-01. National Biological Service, Cooperative Park Studies Unit, University of California, Davis.

Fellers, G. M. and P. M. Kleeman. 2007. California red-legged frog Rana draytonii movement and habitat use: Implications for conservation. Journal of Herpetology 41(2):276-286.

Flores, M., C. Kvamme, B. Rust, K. Takenaka, and D. Young. 2013. BAER Assessment Soils Report – Rim Fire. 34p. Unpublished document. On file with: USDA Forest Service, Stanislaus National Forest, Resource Management Program Area, 19777 Greenley Road, Sonora, CA 95370.

Gorman, J. B. 1954. Biosystematic studies of the salamanders of the Genus Hydromantes. PhD dissertation.

Gresswell, R. E. 1999. Fire and aquatic ecosystems in forested biomes of North America. Transactions of the North American Fisheries Society 128(2):193-221.

Hammond, J. A., J. R. Spotila, and E. A. Standora. 1988. Basking behavior of the turtle Pseudemys scripta: effects of digestive state, acclimation temperature, sex, and season. Physiological Zoology 61(1):69-77.

Hayes, M.P. and M.R. Jennings. 1988. Habitat correlates of distribution of the California red-legged frog (Rana aurora draytonii) and the foothill yellow-legged frog (Rana boylii): Implications for management. Pp. 144-158. *In*: R. C. Szaro, K. E. Severson, and D. R. Patton (technical coordinators), Proceedings fo the symposium on the management of amphibians, reptiles, and small mammals in North America. United States Department of Agriculture, Forest Service, General Technical Report RM-166.

Holland, D. C. 1994. The western pond turtle: Habitat and history. Final Report. Project number 92-068. 293 pp.

Jennings, M. R. and M. P. Hayes. 1994. Amphibian and reptile species of special concern in California. Final report submitted to the California Department of Fish and Game, Inland Fisheries Division, 1701 Nimbus Road, Rancho Cordova, CA 95701 (under contract number 8023). 255pp.

Knapp, R.A. and R.K. Matthews. 2000. Non-native fish introductions and the decline of the mountain yellow-legged frog from within protected areas. Conservation Biology, 14(2):428–438.

Kupferberg, S. J. 1996. Hydrologic and geomorphic factors affecting conservation of a river-breeding frog (*Rana boylii*). Ecological Applications 6(4):1332-44.

Lannoo, Michael. 2005. Amphibian declines: The conservation status of United States species. 1094pp.

Lind, A. J. 2005. Reintroduction of a declining amphibian: determining an ecologically feasible approach for the foothill yellow-legged frog (*Rana boylii*) through analysis of

decline factors, genetic structure, and habitat associations. Doctoral Dissertation, University of California, Davis. 182p.

Matthews, K. R., and K. L. Pope. 1999. A telemetric study of the movement patterns and habitat use of *Rana muscosa*, the mountain yellow-legged frog, in a high-elevation basin in Kings Canyon National Park, California. Journal of Herpetology 33:615–624.

Matthews, K. R. and H. K. Preisler. 2010. Site fidelity of the declining amphibian *Rana sierrae* (Sierra Nevada yellow-legged frog). Canadian Journal of Fisheries and Aquatic Sciences 67:243-255.

McBain, S. and B. Trush. 2004. Attributes of bedrock Sierra Nevada river ecosystems. *Stream Notes*. U. S. Forest Service, Stream Systems Technology Center, Rocky Mountain Research Center, Fort Collins, CO. January 2004:1-4.

Montgomery, D. R., T. B. Abbe, J. M. Buffington, N. P. Peterson, K. M. Schmidt, and J. D. Stock. 1996. Distribution of bedrock and alluvial channels in forested mountain basins. Nature 381:587-589.

Moody, J. A. and D. A. Martin. 2001. Initial hydrologic and geomorphic response following a wildfire in the Colorado Front Range. Earth Surface Processes and Landforms 26:1049-1070.

Moore, M. J. C. and R. A. Seigel. 2006. No place to nest or bask: effects of human disturbance on the nesting and basking habitats of yellow-blotched map turtles (*Graptemys flavimaculata*). Biological Conservation 130:386-393.

Moyle, P. B. 2002. Inland fishes of California. University of California Press. 502pp.

Mullally, D. P. and J. D. Cunningham. 1956. Ecological relations of *Rana muscosa* at high elevations in the Sierra Nevada. Herpetologica 12:189-198.

Pope, K. 1999. Mountain yellow-legged frog habitat use and movement patterns in a high elevation basin in Kings Canyon National Park. Unpublished MS Thesis, California State Polytechnic University, San Luis Obispo, California. 64 p.

Rathbun, G. B., N. J. Scott, and T. G. Murphey. 2002. Terrestrial habitat use by Pacific pond turtles in a Mediterranean climate. Southwestern Naturalist 47(2):225-235.

Reese, D. A. 1996. Comparative demography and habitat use of western pond turtles in northern California: the effects of damming and related alterations. Doctoral dissertation, University of California, Berkeley. 272pp.

Reese, D. A. and H. H. Welsh. 1997. Use of terrestrial habitat by western pond turtles, *Clemmys marmorata*: Implications for management. *In* J. Van Abbema (ed.), Proceedings: Conservation, restoration, and management of tortoises and turtles – an

international conference, pp. 352-357. WCS turtle recovery program and the New York Turtle and Tortoise Society, New York.

Rodríguez-Prieto, I. and E. Fernández-Juricic. 2005. Effects of direct human disturbance on the endemic Iberian frog *Rana iberica* at individual and population levels. Biological Conservation 123(1):1–9.

Rombough, C. J. and M. P. Hayes. 2005. Novel aspects of oviposition site preparation by foothill yellow-legged frogs (*Rana boylii*). Northwestern Naturalist 86:157-160.

Stewart, C., K. Wright, E. Fudge, C. Shannon, B. Hill, Z. Croyle, T. Weddle, D. Coe, and M. Hartzell. 2013. Hydrology and watershed report, Rim Fire BAER assessment. 31p. Unpublished report. On file with: On file with: USDA Forest Service, Stanislaus National Forest, Resource Management Program Area, 19777 Greenley Road, Sonora, CA 95370.

Tatarian, P. J. 2008. Movement patterns of the California red-legged frog (*Rana aurora draytonii*) in an inland California environment. Herpetological Conservation and Biology 3(2):155-169.

USDA. 1991. Stanislaus National Forest Land and Resources Management Plan. Stanislaus National Forest, Sonora, CA.

USDA. 2001. Sierra Nevada Forest Plan Amendment, Final Environmental Impact Statement. Pacific Southwest Region, Vallejo, CA.

USDA. 2004. Sierra Nevada Forest Plan Amendment. Final Supplemental Environmental Impact Statement. Record of Decision. Pacific Southwest Region, Vallejo, CA.

USDA. 2008. Streamscape Inventory (SSI) Technical Guide, Version 3.0. Stanislaus National Forest, Sonora, CA. 31p.

USDA. 2010a. Stanislaus National Forest Plan Direction. Stanislaus National Forest, Sonora, CA.

USDA. 2010b. Stanislaus National Forest StreamScape Inventory (SSI) database. Stanislaus National Forest, Sonora, CA.

USDA. 2010c. Stanislaus National Forest Aquatic Survey Database (AquaSurv). Stanislaus National Forest, Sonora, CA.

USDA. 2013. Bagley Fire: Erosion and sedimentation investigation. Interim Report. Shasta-Trinity National Forest, Redding, CA. 46p.

USDA. 2014. Rim Fire Recovery Project EIS. Specialist report – aquatic biological resources. Stanislaus National Forest, Sonora, CA.

U. S. Fish and Wildlife Service (USFWS). 2002. Recovery plan for the California red-legged frog (*Rana aurora draytonii*). U. S. Fish and Wildlife Service, Portland, Oregon. viii + 173 pp.

U. S. Fish and Wildlife Service (USFWS). 2014. Programmatic Biological Opinion on Nine Forest Programs on Nine National Forests in the Sierra Nevada of California for the Endangered Sierra Nevada Yellow-legged Frog, Endangered Northern Distinct Population of Mountain Yellow-legged Frog, and Yosemite Toad. Service File FF08ESMF00-2014-F-0557. U. S. Fish and Wildlife Service, Sacramento, California.

U. S. Geological Survey. Biological, habitat, and water quality conditions in the upper Merced River drainage, Yosemite National Park, California, 1993-1996. By Larry Brown and Terry M. Short. Water-Resources Investigations Report 99-4088. 64p.

Vredenburg, V.T., G. Fellers, and C. Davidson. 2005. The mountain yellow-legged frog (*Rana muscosa*). In Lannoo, M.J. (Ed.), Status and Conservation of U.S. Amphibians. University of California Press, Berkeley, California, USA.

Wengert, G. 2008. Habitat Use, Home Range, and Movements of Mountain Yellow-legged Frogs (*Rana muscosa*) in Bean and Spanish Creeks on the Plumas National Forest. Final Report to the Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service. Sacramento, CA 32 pp.

Wheeler, C. A., H. H. Welsh, Jr., and L. L. Heise. 2003. *Rana boylii* (foothill yellow-legged frog): oviposition behavior. Herpetological Review 34(3):234.

Yarnell, S. M., C. A. Bondi, A. J. Lind, and R. A. Peek. 2011. Habitat models for the foothill yellow-legged frog (*Rana boylii*) in the Sierra Nevada of California. Center for Watershed Sciences Technical Report, University of California, Davis. 75p.

Young, M. K., R. E. Gresswell, and C. H. Luce. 2003. The effects of wildland fire on aquatic ecosystems in the Western USA. Forest Ecology and Management 178 (1-2):1-229.

Zeiner, D. C., W. F. Laudenslayer, Jr., K. E. Mayer, and M. White, ed. 1988. California's wildlife. Volume I. Amphibians and reptiles. California Statewide Wildlife Habitat Relationships System. Department of Fish and Game, The Resources Agency, Sacramento, Ca. 272pp.

Zweifel, R.G. 1955. Ecology, distribution, and systematics of frogs of the *Rana boylei* group. University of California Publications in Zoology 54(4):207–292.