Rim Fire Recovery Project (43033)

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:

Steven J. Holdeman, Forest Aquatic Biologist — 8/25/2014 Date

Laura Conway, Fish and Wildlife Biologist — 8-13-14 Date

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

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

PROJECT:
Rim Fire Recovery 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:
Salvage logging, roadside hazard tree removal, and road maintenance.

INTRODUCTION:
The purpose of this Biological Evaluation (BE) is to review the Rim Recovery 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. A separate Biological Evaluation was completed to analyze the potential effects (direct, indirect, and cumulative) to federally listed species for all of the proposed alternatives. An additional document, a Biological Assessment, has been prepared 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:

Crispin Holland, the Stanislaus National Forest Wildlife, Fish, and Botany Program Coordinator alerted Jeremiah Karuzas of the Sacramento office of the US Fish and Wildlife Service several days after the Rim Fire started to notify him there may be impacts from the fire or fire suppression activities to listed species, including the VELB and several listed and candidate amphibian species. During preparation of the wildlife portion of the Burned Area Emergency Response report, Roy Bridgman also contacted Mr. Karuzas to discuss the level of concern and risk to VELB associated with any necessary roadwork.

Roy Bridgman and Marcie Baumbach, Stanislaus National Forest biologists, conducted a field trip with Mr. Karuzas through the Rim Fire burn area on November 4th, 2013 and discussed conditions and concerns for listed species. Lucas Wilkinson discussed aquatic species with Mr. Karuzas on the same day.

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, and updated on April 17, 2014 (Document 140417112513). The USFWS list was used as a basis for determining which species should be considered in the Biological Assessment (BA).

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 Recovery 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 "[p]rovide 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) that include the following element:

- RCO 3: Ensure a renewable supply of large down logs that can reach the stream channel and provide suitable habitat within and adjacent to the Riparian Conservation Area.

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 and 4) 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. More comprehensive descriptions of the alternatives are found later in the document.

Alternative 1 (Proposed Action)

This is the Proposed Action, as described in the Notice of Intent (78 Federal Register 235, December 6, 2013; p. 73498-73499), with corrections based on updated data and map information and completion of PAC re-maps as stated in the scoping package. These corrections and refinements provide additional resource protection and a more accurate and informed proposed action. Alternative 1 (Proposed Action) includes the treatments and actions described below. Table 1 provides a summary of the proposed activities and Appendix E (Treatments) provides detailed information for each specific treatment unit.

Salvage and Fuel Reduction

Alternative 1 includes salvage logging on up to 28,326 acres including 24,127 acres of ground based, 16 acres of ground based/skyline swing, 2,930 acres of helicopter, and 1,253 acres of skyline treatments. Proposed fuel treatments include: 7,626 acres of biomass removal, 24,143 acres of machine piling and burning and 4,199 acres of jackpot burning.

Hazard Tree Removal and Fuel Reduction

Fell and remove hazard trees (green and dead) adjacent to 341 miles of forest roads outside of proposed salvage units, amounting to 16,315 acres. Some non-merchantable trees may be felled and left in place.

Roads

Alternative 1 includes 5.4 miles of new road construction, 319.9 miles of route reconstruction and 216.1 miles of road maintenance along low standard roads. About 3.9 miles of temporary road construction (new), 9.3 miles of temporary road construction (existing), and 8.4 miles of existing temporary use routes tied to current and future uses would be used for the project and then reverted afterwards to their original use.

Wildlife Habitat Enhancement

Within Critical Winter Deer Range and adjacent to Yosemite National Park units were identified for salvage and/or biomass removal to achieve desired forage/cover ratios and to provide for deer passage and access. These units encompass 1,351 acres and include: L03, L06, L07, L202, L203A, L203B, L204A, L204B, L205, L206, M201, O201, and P201.

Alternative 2 (No Action)

Alternative 2 (No Action) provides a baseline for comparison with the other alternatives (Table 1). Under Alternative 2 (No Action), general salvage and hazard tree abatement and removal adjacent to lower standard roads would not occur. Current management plans would continue to guide management of the project area. None of the viable timber would be removed from this area leaving tens to hundreds of tons of fuel per acre once these trees fall down and rendering access for firefighting virtually impossible. No hazard tree removal would occur adjacent to lower standard roads, leaving thousands of existing hazard trees to fall on their own as a result of natural forces. These roads would likely remain closed to public access. The cost of future activities where removal of this material is essential to implementation would be far more expensive and perhaps become cost prohibitive. The road maintenance and reconstruction would not be implemented to accomplish the project goal of a properly functioning road infrastructure.

Alternative 3

Alternative 3 responds to issues and concerns related to: Snag Forest Habitat; New Road Construction, Wildlife Habitat; and, Soil and Watershed Impacts. Compared to Alternative 1, it addresses those issues by proposing: additional wildlife habitat enhancement (including biomass removal in Critical Deer Winter Range and the FCCC Forest Plan Amendment); additional soil and watershed protection (mastication and drop and lop); and, less new road construction. It also includes research to help answer wildlife, fuels, watershed, and soils questions. Alternative 3 includes the treatments and actions described below. Table 1 provides a summary of the proposed activities.

Salvage and Fuel Reduction

Alternative 3 salvage and fuels treatments are similar to Alternative 1; however, it includes two additional fuel treatments (mastication and drop and lop) to mitigate impacts of the fire and logging on soil and water resources.

Alternative 3 includes salvage logging on up to 30,399 acres including 26,252 acres of ground based, 16 acres of ground based/skyline swing, 3,035 acres of helicopter, and 1,096 acres of skyline treatments. Proposed fuels treatments include: 8,379 acres of biomass removal, 22,036 acres of machine piling and burning and 4,147 acres of jackpot burning, 1,309 acres of mastication, and 2,228 acres of drop and lop.

Hazard Tree Removal and Fuel Reduction

Alternative 3 involves felling and removing of hazard trees (green and dead) adjacent to 314.8 miles of forest roads, amounting to 15,253 acres, outside of proposed salvage units. Some non-merchantable trees may be felled and left in place.

Roads

Alternative 3 includes 1.0 mile of new road construction, 323.6 miles of road reconstruction and 200.6 miles of road maintenance along low standard roads. It also includes 9.5 miles of temporary road construction (new), 22.7 miles of temporary road construction (existing), and 3.3 miles of existing temporary roads tied to current and future uses would be used for the project and then reverted afterwards to their original use.

Wildlife Habitat Enhancement

Alternative 3 includes several additional treatment units to enhance the Critical Deer Winter Range (Appendix E). In addition, the FCCC Forest Plan Amendment provides for long-term movement of wildlife from Yosemite National Park through the Stanislaus National Forest.

Research

Alternative 3 includes research projects that would collect data on California spotted owl use of protected area centers affected by fire, black-backed woodpecker response to fire, and hillslope sedimentation.

Forest Plan Amendment

Alternative 3 includes a Forest Plan Amendment designating a 4 mile wide Forest Carnivore Connectivity Corridor (FCCC), as habitat for old-forest habitat associated species, particularly forest carnivores (portions of this corridor also overlap critical deer range). The corridor would lead from Yosemite National Park and North Mountain Inventoried Roadless Area (IRA) west to the Clavey River. The corridor includes the following proposed units that would be managed for Old Forest Emphasis: L02, L05, M1 through M10, M12, M13, M15, M16, M18, M19, and N1. This Forest Plan Amendment changes the land allocation on 9,923 acres from General Forest to Old Forest Emphasis Area (OFEA). Other existing land allocations (Wild and Scenic River, PAC, HRCA, and OFEA) allocations would remain unchanged.

Alternative 4

Alternative 4 is similar to Alternative 3 except that it replaces new road construction with temporary roads and drops 2,500 acres of salvage logging in highly suitable black-backed woodpecker habitat.

Alternative 4 responds to issues and concerns related to: Snag Forest Habitat; New Road Construction, Wildlife Habitat; and, Soil and Watershed Impacts by proposing the same action items as Alternative 3 for wildlife habitat enhancement (including biomass removal in Critical Deer Winter Range and the FCCC Forest Plan Amendment) and, soil and watershed protection (mastication and drop and lop). It also includes research to help answer wildlife, fuels, watershed, and soils questions. Compared to Alternative 3, Alternative 4 further addresses the Snag Forest Habitat issue with additional black-backed woodpecker habitat retention and, the New Road Construction issue with no new road construction. Alternative 4 includes the treatments and actions described below. Table 1 provides a summary of the proposed activities and Appendix E (Treatments) provides detailed information for each specific treatment unit.

Salvage and Fuel Reduction

Alternative 4 includes salvage logging on up to 27,826 acres including 24,176 acres of ground based, 16 acres of ground based/skyline swing, 2,568 acres of helicopter, and 1,066 acres of skyline treatments. Proposed fuels treatments include: 7,975 acres of biomass removal, 20,320 acres of machine piling and burning and 3,650 acres of jackpot burning, 1,309 acres of mastication, and 1,798 acres of drop and lop.

Hazard Tree Removal and Fuel Reduction

Alternative 4 involves felling and removing of hazard trees (green and dead) adjacent to 324.6 miles of forest roads, amounting to 15,692 acres, outside of proposed salvage units. Some non-merchantable trees may be felled and left in place.

Roads

Alternative 4 includes 315.0 miles of route reconstruction and 209.3 miles of road maintenance along low standard roads. Alternative 4 does not include new road construction. It includes 8.4 miles of temporary road construction (new), 22.1 miles of temporary road construction (existing) and 3.3 miles of existing temporary use routes tied to current and future uses would be used for the project and then reverted afterwards to their original use.

Wildlife Habitat Enhancement

Alternative 4 includes the same wildlife enhancement treatments as Alternative 3.

Research

Alternative 4 includes the same research treatments as Alternative 3.

Forest Plan Amendment

Alternative 4 includes the same FCCC Forest Plan Amendment as Alternative 3.

Table 1. Summary the actions proposed under each alternative.

Proposed Treatments[1]	**Alternative 1** (Proposed Action)	**Alternative 2** (No Action)	**Alternative 3**	**Alternative 4**
Salvage ground based (acres)	24,127	0	26,252	24,176
Salvage ground based/skyline swing (acres)	16	0	16	16
Salvage aerial based helicopter (acres)	2,930	0	3,035	2,568
Salvage skyline system (acres)	1,253	0	1,096	1,066
Subtotal Salvage (acres)	**28,326**	**0**	**30,399**	**27,826**
Hazard Tree Removal along Level 2 roads (miles)	341	0	314.8	324.6
Subtotal Hazard Tree Removal (acres)	**16,315**	**0**	**15,253**	**15,692**
Total Hazard Tree and Salvage (acres)	**44,641**	**0**	**45,652**	**43,518**
Biomass Removal	7,626	0	8,379	7,975
Mastication	0	0	1,309	1,309
Drop and Lop	0	0	2,228	1,798
Machine Piling and Burning	24,143	0	22,036	20,320
Jackpot Burning	4,199	0	4,147	3,650
Total Fuels Treatments (acres)	**35,968**	**0**	**38,099**	**35,052**
Route New Construction (miles)	5.4	0	1.0	0
Route Maintenance (miles)	216.1	0	200.6	209.3
Route Reconstruction (miles)	319.9	0	323.6	315.0
Subtotal Construction and Maintenance (miles)	**541.4**	**0**	**525.2**	**524.3**
Temporary Route (new miles)	3.9	0	9.5	8.4
Temporary Route (existing miles)	9.3	0	22.7	22.1
Temporary Use – Revert (miles)	8.4	0	3.3	3.3
Subtotal Temporary Routes (miles)	**21.6**	**0**	**35.5**	**33.8**
Total Route Treatments (miles)	**563.0**	**0**	**560.7**	**558.1**
Private Roads Needing Right-of-Way (miles)	11.2	0	11.2	11.2
Rock Quarry Sites	7	0	7	7
Potential Water Sources	81	0	81	81

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 Recovery 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) was prepared 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 2. Stanislaus National Forest Sensitive Species and federally-listed species potentially occurring within or near the Rim Recovery 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, Proposed for federal listing	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 Proposed for federal listing	G = Y E = N, >5,000' locally	>3 miles (northeast) @ Bourland Cr.	Breeding: 1bc, 2 General: 1bc, 2	N	N	[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 3. 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 3. 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.

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 4. 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 harvest 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 harvest 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 harvest 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. Suitable aquatic breeding habitat 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. Aquatic non-breeding habitats share many of the characteristics breeding habitats do, but they may lack adequate water depth to allow for completion of the species life cycle. Upland habitats 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 Recovery 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 Grapevine 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.

Table 5 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 5. 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
	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	South Fork Tuolumne River	57,855	Unknown	Yes	29.4	704

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)
River						
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.

Table 6 shows the streams, ponds, and meadow with known WPT populations and lists the primary streams that provide suitable habitat for the turtle.

Table 6. 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	Middle Fork Tuolumne River	Yes	Yes	25.5	5365
	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	South Fork Tuolumne	Yes	Yes	29.4	6411

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	River				
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

AFFECTED ENVIRONMENT

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

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.

<u>Expectations for the watersheds affected by the Rim Fire</u>

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 Recovery Project) detail erosion and sedimentation, the hydrology reports (BAER and Rim Recovery 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 7 displays the anticipated changes in stream flow and sediment delivered to the stream channel at the most downstream point in the watershed.

Table 7. 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
		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

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)
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 Recovery 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 8 lists the watersheds suitable for FYLF and expected level of watershed response.

Table 8. 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 8. 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
- percentage 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. Once this intersection of project activities and habitat buffer was established, the type of logging system used, volume estimates for "recovered" trees, road action types, and water use from designated sources were evaluated to conceptualize an intensity of activity occurring within each occupied or suitable watershed. This estimate was used to provide a point of reference for the amount of project-related activity occurring close to streams and provide a basis for assigning risk of direct and indirect effects to the species and their habitats. Since the types of actions in each action alternative were not different (only the amount of each activity differed), this approach was considered to be applicable to all of the alternatives. For cumulative effects analysis, an internal planning effort identified all ongoing and planned activities on public and private lands. For public lands, ongoing actions (e.g., livestock grazing) and planned activities (e.g., Rim Fire Hazard Trees project) were identified on National Forest System and National Park Service (Yosemite NP) lands. For private lands, emergency timber plans were retrieved from CalFire to identify the areas where salvage logging occurred or is proposed to occur.

The spatial boundary for analyzing cumulative effects to FYLF and WPT occurred at several different scales. For some small watersheds (7th and 8th level HUC and smaller) that are occupied or provide suitable habitat, cumulative effects were narrowed to the scale of the watershed. The reason this was done is to provide a detailed look at the activities that could affect small, isolated populations. Populations and individuals inhabiting these smaller streams are expected to remain within the watershed and complete all life stages in the watershed. Therefore, actions occurring outside of the small watershed, but within the larger 5th or 6th level HUC, may have no cumulative bearing on the isolated populations. Examples of smaller watersheds include Grapevine (7th level HUC) and Drew (8th level HUC) Creeks and the small, unnamed Clavey River tributaries (sub-8th level HUC). The spatial scale was also expanded out to larger watershed scales to address populations occurring in larger habitats, like the Clavey

River. The downstream extent of the analysis area is Don Pedro Reservoir for the Tuolumne River watershed and the upper North Fork Merced River 5th level HUC.

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, precipitation was considerably below average (less than 50%) and the precipitation events that occurred during the 2013-2014 winter were relatively low in intensity. 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 2014 growing season may be less than expected, if we were to expect a “normal” or average precipitation year.

Because ground cover is an important factor in post-fire erosion rates, the low ground cover conditions that are likely in the coming year may not be adequate to naturally mitigate erosion rates during the winter of 2014-2015. At this point in time, it is impossible to determine what the 2015-2015 precipitation year will be and post-fire watershed responses may be higher next year than they were in 2013-2014. We are fairly certain that some degree of salvage logging will occur on public lands to mitigate

roadside hazards from dead trees on the primary roads (maintenance level 3-5) on the forest. If additional salvaging occurs as a result of the Rim Fire Recovery Project, logging operations could influence watershed response in ways that are unforeseen at this point in time. Assumptions about vegetative recovery and ground cover made in the analyses that this report relies upon (watershed and soils) may not be accurate. Sedimentation of aquatic habitats may be greater following the second winter than the first winter post-fire. However, the sediment modeling completed for this project should be sufficient to capture the magnitude of sediment that could be delivered to streams post-implementation and is considered adequate to allow for the application of effects analysis in subsequent years.

Species specific effects

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 have not been completed for the frog within the project area, 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 accidental spill of Sporax®, and increased sedimentation as a result of mechanical operations and soil compaction.

Roadside Hazard and Salvage and Fuels Treatments

Effects to individuals are mainly associated with the operation of equipment, presence of forest workers in suitable habitats for the frog, and water drafting. If equipment operates in suitable habitat, there is the risk of injury or mortality if an individual frog does not escape the area when the disturbance is initiated. As activities become 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 small. The amount of proposed operation within upland habitat is used as an indicator of risk.

Physical disturbance is also a direct impact to individuals and is associated with equipment operation and forest workers in close proximity to suitable habitats. Repeated disturbances can alter the fitness of individuals as it can interrupt typical feeding and resting patterns. If an individual is repeatedly disturbed in an area, they may avoid the area, essentially being temporarily displaced from their preferred habitat. Prolonged changes to behavior or displacement from its habitat may detrimentally impact an individual's fitness (Rodriguez-Prieto and Fernandez-Juricic 2005). As described above, 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 operation to the stream, the amount potential aquatic habitat within project activities is used as an indicator of risk.

Indirect impacts to individuals can occur as a result of habitat modification associated with excessive sedimentation of habitat. As sediment is supplied in excess 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 (Bobzien and DiDonato 2007). If these refuge habitats are limited, there could be an increase in predation. California red-legged frog tadpoles feed on algae and adult frogs feed on macroinvertebrates (Federal Register 1996). 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.

Effects to habitat include reduction in shading, damage to riparian cover and streambanks, chemical contamination, increases sedimentation of aquatic habitats and reduction in large woody debris (LWD) from streams and upland habitats. Salvage logging would remove trees from riparian areas within the project area. The consequent impact to habitat is not known, but it could have positive or neutral benefit to the riparian habitat. Removal of stream shade can increase water temperature which can increase growth of emergent and aquatic vegetation, or can raise temperatures to the point frogs do not use the habitat. However, the net effect of salvaging dead trees may not be very big because the dead trees do not provide much shade, thereby making the effect somewhat neutral. The operation of equipment can potentially damage cover in upland riparian 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. The consequences of the loss of cover provided by riparian vegetation would be 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 vegetation would likely regrow within a year.

The proposed action includes the use of a registered borate compound (example, Sporax® and hereafter referred to as Sporax®) to limit the spread of fungal disease to recently cut trees/stumps. Stump treatments are unlikely to harm aquatic animals because the method of application and project design measures would limit the potential for adverse acute and chronic exposures. A risk assessment was prepared for the project to address potential exposure scenarios (acute accidental, acute non-accidental, and chronic) for the application of the borate compound. The risk is more fully described under SNYLF. The MRs proposed for the project would effectively mitigate the direct effects to habitat. These MRs include limiting the distance to streams for equipment operation.

There could be an increased rate of sediment delivery to the streams following roadside hazard abatement, salvage logging, machine piling, and pile burning. These activities create soil disturbance and compaction that leads to increase erosion and sedimentation. The roadside hazard tree removal has a potential for increasing sediment delivery to aquatic systems because ground based equipment is used and the logs are dragged along the ground, both creating soil disturbance. However, the potential for biologically important levels of sedimentation is low because the area affected is limited (200 feet on either side of the road), there is no skid trail network, and the trees are felled away from the stream so that they can be endlined (pulled by then end of the log furthest away from the stream) by the skidder which limits operation close to the stream. 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).

Salvage logging (including hazard tree removal) would reduce the supply of large woody debris (LWD) in units that encompass or lie immediately adjacent to a stream. The removal of dead trees in riparian areas has the potential to reduce the availability of LWD that falls into the stream or riparian area. LWD creates habitat complexity in a stream by trapping sediment upstream and creating pools downstream of the LWD obstruction. LWD in uplands habitats provide cover and refugia for adult frogs. A MR is in place for recruiting the largest trees along perennial streams in salvage units that would potentially mitigate the overall reduction in LWD recruitment. However, this is considered to be a minimal amount of retention (5 trees per acre) and there would be a very long term (greater than 150 years and up to 300 years for very large trees) reduction in LWD recruitment rate in streamside salvage units.

Road Management

All road actions that improve or create a new road surface have the potential to increase erosion from the road surface and result in sedimentation of aquatic habitats if there is hydrologic connectivity between the road and a stream. Roads that are connected hydrologically to the stream have a higher potential to increase sediment delivery. Reconstruction and maintenance actions are primarily intended to facilitate vehicle use, but limiting hydrologic connectivity to streams is another important aspect of these treatments. Outsloping roads and installing effective water diversion structures can have long term benefits to aquatic systems by reducing the amount of sediment delivered from the road. So, there is a tradeoff for streams with road treatments with increased sediment delivery in the short term (1 to 2 years) and decreased delivery in the long term (greater than 2 years). Temporary roads would be vulnerable to erosion as described above, but these roads are not expected to have long-term effects to aquatic habitats because they would be fully decommissioned after use, meaning any culverts or culvert fills would be removed and the road surface would be subsoiled to break up compaction. New roads would require the development of the road prism and installation of culverts and other drainage structures (rolling dips). These roads would remain available to use for a long period and have the potential to generate sediment that could be delivered to streams. Management requirements and BMPs are included as part of the implementation of the

proposed road actions and are designed to minimize the erosion of the road surface and delivery of sediment to streams.

Water Sources and Rock Pits

Water drafting is required by the project for dust abatement on roads. Eighty one potential drafting sites were identified for use project-wide during implementation of the project. 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. Five drafting locations were identified for Hunter Creek, one at the 1N01 crossing and four sites in headwater tributaries. To mitigate the potential for entrainment, MR would be applied to drafting operations. These include use of low intake velocity pumps and a screening device placed around the pump intake. These requirements would be effective at minimizing effects to the frog at the 1N01 crossing. At the four smaller drafting sites, a temporary holding tank would be used to accumulate water for drafting, not drafting directly from the stream.

Specific effects by habitat area are described below. Table 8 displays the indicators for each alternative and is shown as the amount of impact to the total amount of available habitat for the CRLF. Table 9 displays the acres and miles of proposed treatments in each habitat area. Table 10 displays the miles of California red-legged frog non breeding stream habitat within proposed treatments. There is no California red-legged frog breeding stream habitat within proposed treatments.

Table 8. CRLF and SNYLF direct and indirect effect indicators for each alternative.

Indicator	Alt 1	Alt 2	Alt 3	Alt 4
California red-legged frog				
Miles of suitable breeding stream within units/hazard tree	0(0)	0(0)	0(0)	0(0)
Acres of breeding ponds within units/ hazard tree	0.2 (1.9)	0(0)	0.1 (1.4)	0.1 (1.4)
Miles of perennial and intermittent non-breeding aquatic habitat within units/hazard tree				
Perennial and Intermittent	7.0 (2.1)	0(0)	5.8 (1.7)	5.8 (1.7)
Acres of upland habitat within units/hazard tree treatments	2,686 (12.4)	0.0(0)	2,467 (11.4)	2,467 (11.4)
Miles of road treatment within upland habitat buffer	49.8	0.0(0)	46.6	46.6
Maintenance	40.6	0.0(0)	36.8	36.8
Reconstruction	8.2	0.0(0)	8.3	8.3
Temporary	1.0	0.0(0)	1.6	1.6
Sierra Nevada yellow-legged frog				
Miles of suitable breeding /non-breeding stream within units/hazard tree	1.0 (38)	0 (0)	1.0 (38)	1.0 (38)
Acres of breeding/non-breeding pond within units/hazard tree	1.3 (100)	0 (0)	1.3 (100)	0.7 (53.8)
Acre of upland habitat within units/hazard tree treatments	14.3(8.4)	0 (0)	14.3 (8.4)	12.7 (7.4)
Miles of road treatment within upland habitat buffer				
Maintenance or Reconstruction	0.2	0.0(0)	0.2	0.2

Birch and Mud Lakes

There are no activities proposed in the immediate vicinity of Mud Lake and all proposed activities occur downstream and/or downslope of the breeding habitat. 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 will remain low post-implementation.

There are 2.2 miles of non-breeding habitat within proposed salvage units (Table 10) out of 7.4 miles in the habitat area (30 percent). The non-breeding habitat in the Tuolumne River – Poopenaut Valley watershed (north half of habitat area) only has proposed treatment at the headwaters of the stream. Most of the non-breeding aquatic habitat in the Lower Middle Fork Tuolumne River and Upper Middle Fork Tuolumne River watershed is within proposed salvage harvest. WEPP modeling does not show a change in post-implementation erosion in the Tuolumne River – Poopenaut Valley or Upper Middle Fork Tuolumne River watersheds. Although no change is shown it is likely that implementation activities will result in some erosion and there will be some sediment delivery to the stream. The amount is not detectable above the background of the predicted fire erosion. The Lower Middle Fork Tuolumne watershed modelling indicates erosion will be reduced from 2.9 tons per acre post fire to 2.8 tons per acre post-implementation. Despite the predicted decrease in erosion, some sediment is still likely to enter the non-breeding aquatic habitat due to salvage, hazard tree and fuel reduction treatments.

Table 9: Treatments in California red-legged frog upland habitat by alternative

Treatment	Habitat Area	System	Alt. 1	Alt. 3	Alt. 4
Salvage (acres)	Birch and Mud Lakes	Tractor	691.4 (24%)	680.4 (23%)	680.7 (23%)
		Skyline	5.0 (0.2%)	6.2 (0.2%)	6.2 (0.2%)
	Drew Creek	Tractor	40.6 (1%)	35.9 (1%)	35.9 (1%)
	Harden Flat Ponds	Tractor	129.6 (9%)	130.8 (9%)	130.8 (9%)
		Skyline	44.2 (3%)	27.6 (2%)	27.6 (2%)
		Helicopter	0	16.6 (1%)	16.6 (1%)
	Homestead Ponds	Tractor	35.8 (2%)	26.6 (1%)	26.7 (1%)
Roadside Hazard (acres)	Birch and Mud Lakes	Tractor	104.9 (4%)	113.7 (4%)	113.7 (4%)
	Drew Creek	Tractor	311.5 (9%)	224.3 (6%)	224.3 (6%)
	Harden Flat Ponds	Tractor	33.6 (2%)	32.8 (2%)	32.8 (2%)
	Homestead Ponds	Tractor	145.9 (7%)	34.8 (2%)	34.8 (2%)
	Hunter Creek and Ponds	Tractor	1137.4 (10%)	1137.4 (10%)	1137.0 (10%)
Road Management (miles)	Birch and Mud Lakes	Maintenance	0.49	0.75	0.75
		Reconstruct	4.78	4.52	4.52
		Temporary road	0	1.16	1.16
	Drew Creek	Maintenance	8.41	6.63	6.63
		Reconstruct	0	0.70	0.7
		Temporary road	0.95	0.13	0.13
	Harden Flat Ponds	Maintenance	0.28	0.37	0.37
		Reconstruct	2.10	1.92	1.92
		Temporary road	0	0.09	0.09
	Homestead Ponds	Maintenance	5.05	2.73	2.73
		Reconstruct	1.27	1.05	1.05
		Temporary road	0	0.22	0.22
	Hunter Creek and Ponds	Maintenance	26.36	26.36	26.36
Water Sources	Drew Creek		1	1	1
	Hunter Creek and Ponds		5	5	5
Rock sources		None located within habitat areas			
Fuels Treatments (acres)	Birch and Mud Lakes	Piling and burning	336.8 (12%)	686.6 (24%)	686.6 (24%)
	Drew Creek	Piling and burning	40.6 (1%)	35.9 (1%)	35.9 (1%)
	Harden Flat Ponds	Piling and burning	157.1 (10%)	158.5 (10%)	158.5 (10%)
		Lop and scatter, jackpot, burning	16.6 (1%)	16.6 (1%)	16.6 (1%)
	Homestead Ponds	Piling and burning	35.8 (2%)	26.7 (1%)	26.7 (1%)
Watershed Sensitive Area Treatments	Birch and Mud Lakes	Drop and lop	0	94.8 (3%)	94.8 (3%)

Table 10: Miles of non-breeding stream habitat within proposed treatment units by alternative

Treatment	Habitat Area	Alt. 1	Alt. 3	Alt. 4
Salvage	Birch and Mud Lakes	2.22 (30%)	2.11 (29%)	2.11 (29%)
	Drew Creek	0.16 (2%)	0.16 (2%)	0.16 (2%)
	Harden Flat Ponds	0.29 (5%)	0.29 (5%)	0.29 (5%)
	Homestead Pond	0 (0%)	0 (0%)	0 (0%)
	Hunter Creek	0 (0%)	0 (0%)	0 (0%)
Roadside Hazard	Birch and Mud Lakes	0 (0%)	0 (0%)	0 (0%)
	Drew Creek	0.81 (8%)	0.05 (0.5%)	0.05 (0.5%)
	Harden Flat Ponds	0.07 (1%)	0.07 (1%)	0.07 (1%)
	Homestead Pond	0.34 (7%)	0 (0%)	0 (0%)
	Hunter Creek and Ponds	3.10 (12%)	3.10 (12%)	3.10 (12%)
Fuels Treatments	Birch and Mud Lakes	0.46 (6%)	2.11 (29%)	2.11 (29%)
	Drew Creek	0.16 (2%)	0.16 (2%)	0.16 (2%)
	Harden Flat Ponds	0.29 (5%)	0.29 (5%)	0.29 (5%)
	Homestead Pond	0 (0%)	0 (0%)	0 (0%)
	Hunter Creek	0 (0%)	0 (0%)	0 (0%)
Watershed Sensitive Area Treatments	Birch and Mud Lakes	0	0.60 (8%)	0.60 (8%)

Removal of salvage will not affect stream shading in this area as dead trees provide little shade. LWD recruitment will be reduced along the non-breeding habitat in the Lower Middle Fork Tuolumne River and Upper Middle Fork Tuolumne River. The MRs maintain 5 standing trees per acre within the Riparian Conservation Areas (RCAs) of perennial streams as recruitment for downed wood. Existing downed wood crossing or within 30 feet of a stream will be retained. There are no planned water sources within this habitat area. Roadside Hazard Tree Removal and road treatments in this area do not occur near aquatic habitat.

Twenty-eight percent of the upland habitat is proposed for harvest and roadside salvage treatment, and 12 percent of the upland habitat with salvage treatment will also have fuels treatment. These activities can further decrease cover from the effects of the fire, and can set back vegetative regrowth by one to two years. 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. 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 salvage units, or within hazard tree removal areas. There is no risk of disturbance or injury at the breeding habitat. Adjacent to the breeding habitat there is planned roadside hazard tree removal that comes close to the breeding habitat in two locations along 1S58. Reduction in stream shading below that caused by the fire is not anticipated, and therefore no increase in temperature is expected.

A total of 10.3 miles of non-breeding stream habitat is within the Drew Creek habitat area. There are 0.16 miles of non-breeding habitat in the Lower Middle Fork Tuolumne River watershed within proposed salvage units and 0.81 miles within roadside hazard tree removal units (total of 10 percent) (Table 10) in the Tuolumne River – Jawbone Creek watershed. WEPP modeling indicates erosion will be reduced from 2.9 tons per acre post fire to 2.8 tons per acre post-implementation in Lower Middle Fork Tuolumne River watershed and will remain at 3.6 tons per acre in the Tuolumne River – Jawbone Creek watershed. It is likely that implementation activities will result in some erosion and there will be some sediment delivery to the streams. The amount is not detectable above the background of the predicted fire erosion.

The proposed activities will not alter stream shading. There is very little activity proposed in this habitat area adjacent to streams and in many areas LWD will not be altered. The area along Lumsden Road where roadside hazard trees will be removed will have LWD maintained as described above. There is one proposed water source in the Drew Creek habitat area. It is a water trough/tank located in Section 21 south of Drew Creek and south of the proposed roadside hazard tree removal. This trough does not currently have any red-legged frog populations in it. Lumsden Road crosses the Tuolumne River within this habitat area at Lumsden Bridge. Road treatments are planned across this non-breeding habitat. Some sediment may enter the stream from the road treatments and may continue for one to two years. However, road treatments are designed to reduce hydrologically connected roads segments and any increased sediment will decrease after two years.

Ten percent of the upland habitat is proposed for harvest and roadside salvage treatment, with 1 percent of the upland habitat also receiving fuels treatments (Table 9). These activities can further decrease cover from the effects of the fire, and can set back vegetative regrowth by one to two years. 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 will have no effect on the existing habitat.

<u>Harden Flat Ponds</u>
The breeding habitat within this habitat area is on private property and is not included within any proposed salvage units, or within hazard tree removal areas. There is no risk of disturbance or injury at the breeding habitat. Breeding habitat will maintain low suitability for red-legged frogs in this area.

There are 0.36 miles of non-breeding habitat in the Lower South Fork Tuolumne River watershed and in the Lower Middle Fork Tuolumne River watershed (Table CRLF5) within salvage and roadside hazard tree treatment units. WEPP modeling indicates erosion will be slightly reduced in the Lower Middle Fork Tuolumne River watershed post-implementation, but will be unchanged in the Lower South Fork Tuolumne River watershed. Even with the predicted decrease post implementation it is likely that implementation activities will result in some erosion and there will be some sediment

delivery to the streams. The amount is not detectable above the background of the predicted fire erosion.

The proposed activities will not alter stream shading. There is very little activity proposed in this habitat area adjacent to streams. Of the 6.4 miles of non-breeding habitat, only 0.36 miles (6 percent) will have trees removed. MRs will maintain some standing trees to provide for LWD recruitment. There are no proposed water sources in this area. None of the proposed road treatments cross stream habitat (they are not hydrologically connected) and it is unlikely sediment from road treatments will reach the streams.

Fourteen percent of the upland habitat is proposed for harvest and roadside salvage treatment (Table 9), with 10 percent also proposed for fuel treatment. These activities can further decrease cover from the effects of the fire, and can set back vegetative regrowth by one to two years. 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 habitat is on the private property and will not be impacted by this action.

Homestead Pond

Homestead Pond is surrounded by a nineteen acre proposed salvage harvest unit. There would be a high risk of direct impact to red-legged frogs in this pond during project activities, mainly from physical disturbance. A 30 foot no cut and no equipment buffer would be applied adjacent to Homestead Pond and mechanical operations would be prohibited within 1 mile of breeding habitat during the wet season when frogs would be most likely to be present in the upland habitats, further reducing the potential for impacts. Reduction in stream shading below that caused by the fire is not anticipated, and therefore no increase in temperature is expected. The pond and salvage unit are on flat ground, therefore sediment is not expected to move into the pond in great quantities. However, some sedimentation is anticipated and would slightly reduce the depth of the pond.

There are 4.8 miles of non-breeding stream habitat within the Homestead Pond habitat area. There are 0.3 miles (7 percent) of non-breeding habitat in the Tuolumne River – Grapevine Creek watershed within proposed roadside hazard tree removal units (Table 10). WEPP modeling indicates erosion will not be reduced from 2.0 tons per acre post fire. It is likely that implementation activities will result in some erosion and there will be some sediment delivery to the non-breeding habitat. The amount is not detectable above the background of the predicted fire erosion.

The proposed activities will not alter stream shading. There is very little activity proposed in this habitat area adjacent to streams and in most of the area LWD will not be altered. There are no proposed water sources in the Homestead Pond habitat area. One road in the project area crosses the non-breeding habitat provided by the Hetch Hetchy ditch feature. Because the road may be hydrologically connected to the non-breeding habitat, some sediment may enter the stream from the road treatments and may continue

for one to two years. These road treatments are designed to reduce hydrologically connected roads segments and any increased sediment will decrease after two years.

Nine percent of the upland habitat is proposed for harvest and roadside salvage treatment (Table 9), with two percent of the habitat proposed for fuels treatment in the harvested units. These activities can further decrease cover from the effects of the fire, and can set back vegetative regrowth by one to two years. 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. There is no dispersal habitat in this habitat area.

Hunter Creek and Ponds

There are no salvage activities proposed within the Hunter Creek and Ponds habitat area. Hazard Tree Removal is proposed near the Hunter Creek breeding habitat in Section 17 (near Skidmore Pit). There is a slight risk of injury or mortality at this location; however this is mitigated by the management requirement to fell trees away from the stream. There will be no reduction in shading at breeding habitats (stream or pond) below that caused by the fire; therefore temperature will not be altered by this project. The proposed hazard tree removal and road treatments in Section 17 may result in a minor amount of additional sediment input into Hunter Creek due to the proximity to the creek. This additional input may last one to two years, and then will be reduced.

There are 26.8 miles of non-breeding stream habitat within this habitat area. There are 3.1 miles (12 percent) of non-breeding habitat within proposed roadside hazard tree removal units (Table 10). The majority of non-breeding habitat consists of tributaries to Hunter Creek in the Lower North Fork Tuolumne River watershed and most was not burned in the Rim Fire. The non-breeding habitat within the Tuolumne River – Grapevine Creek watershed was burned. WEPP modeling indicates erosion will remain at 2.0 tons per acre post fire and post-implementation in this watershed. It is likely that implementation activities will result in some erosion and there will be some sediment delivery to the non-breeding habitat. The amount is not detectable above the background of the predicted fire erosion.

The proposed activities will not alter stream shading. There is very little activity proposed in this habitat area adjacent to streams and in most of the area LWD will not be altered. There are five proposed water sources in the Hunter Creek and Ponds habitat area; one water trough/tank that is not known to contain red-legged frogs, one site at the junction of Hunter Creek and Buchanan Road in breeding habitat, and three sites in non-breeding habitat along Forest Service roads 1N01, 1N27 and 1N35. Drafting in the latter four locations has the potential to entrain tadpole or smaller California red-legged frogs if they are present during activities, and can also result in disturbance in the area. There are several roads in the area that cross non-breeding habitat that provide some hydrologic connectivity. Some sediment may enter the streams from the road treatments and may continue for one to two years. These road treatments are designed to reduce hydrologically connected roads segments and any increased sediment will decrease after two years. Long term reduction in sediment delivery from the roads would be expected following road improvement actions.

Ten percent of the upland habitat is proposed for roadside salvage and fuel treatment (Table 9). These activities can further decrease cover from the effects of the fire, and can set back vegetative regrowth by one to two years. However, only a little more than half of the upland habitat was within the fire and experienced changes. 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. The dispersal habitat along Hunter Creek would not be altered by the proposed activities.

Sierra Nevada yellow-legged frog

All of the direct and indirect effects addressed in this document are common to all locations. The primary direct effects to individuals include mortality, injury, and physical disturbance. The primary direct effects to habitat include reduction in shade, streambank damage, and risk of chemical contamination. Indirect effects to individuals and populations primarily include reduced physiological functioning as a result of repeated disturbance and reduction in food supply and lower population levels are associated with increased predation and reduced recruitment. The primary indirect effect to habitat is the increase in sediment delivery to streams.

Direct effects to individuals are mainly associated with the operation of equipment, presence of forest workers in close proximity to suitable aquatic habitats for the frog, and water drafting. If equipment operates close to a suitable habitat, there is the risk of injury or mortality if the individual does not escape into the water when the disturbance is initiated. Since SNYLF are typically closely associated with water (within a couple of meters), they avoid injury/mortality by retreating into an aquatic habitat. However, the frog can use upland habitats, including refuge habitat under downed woody debris, and be vulnerable to crushing if the equipment hits or runs over the cover object. If there is no operation within the buffer, the risk of direct effect to individuals is considered to be negligible. This risk increases as the amount of buffer affected increases. The consequence of the loss of any individual is considered to potentially have a population-level impact because almost all populations on the forest are assumed to be small. Physical disturbance is also a direct impact to individuals and is associated with equipment operation and forest workers in close proximity to suitable habitats. As noted before, the SNYLF readily retreats into aquatic habitat to escape the disturbance. This retreat behavior could be lethal under narrow circumstances because the individual would be more vulnerable to predation as it is flushed from upland habitat. Because the risk of direct impact is highest when equipment works in close operation to the stream, the amount of proposed operation within a 25 meter upland buffer is used as an indicator of risk.

Water drafting is required by the project for dust abatement on roads. Eighty one potential drafting sites were identified for use during implementation of the project. 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, MR would be applied to drafting operations. These include use of low intake velocity pumps and a screening device placed around the pump intake.

Indirect effect to individuals is associated with repeated disturbance caused by equipment or workers. While generally non-lethal, repeated disturbances may reduce physiological fitness because the disturbance may not allow the individual to forage, bask, or otherwise engage in typical behaviors. As equipment or humans disturb an individual, the most common response is for that individual to avoid the threat and seek cover (typically into water). After this disturbance response, a period of time would elapse before that individual would resume pre-disturbance behavior. This change in an individual's behavior may cause less time feeding, resting, or breeding, and therefore result in a short term change in their energy budget with relatively little physiological consequence. If an individual is repeatedly disturbed in an area, they may avoid the area, essentially being temporarily displaced from their preferred habitat. Prolonged changes to behavior or displacement from its habitat may detrimentally impact an individual's fitness (Rodriguez-Prieto and Fernandez-Juricic 2005).

Indirect impacts to individuals can occur as a result of habitat modification associated with excessive sedimentation of habitat. As sediment is supplied in excess 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 individuals by making them more susceptible to annual freezing and potentially reduce the overwintering success of tadpoles and post-metamorphic individuals. 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. While SNYLF tadpoles typically retreat to deep water, they have also been observed retreating into cover provided by the streambed substrates and fine sediment. If these refuge habitats are limited, there could be an increase in predation. The tadpoles of SNYLF are believed to feed on algae and detritus (Vredenburg, et al. 2005). In stream habitats like those in the project area, the larger substrates and backwater areas provide the algal and detritus resources, respectively. As excessive sedimentation begins to cover the streambed, the substrates used for foraging can also be covered, thereby resulting in decreased opportunities for feeding. An individual frog's physiological health could be reduced if inadequate food resources are available for growth and development. A reduced rate of development could result in an increased time to metamorphosis or smaller size at metamorphosis (Leips and Travis 1994). Smaller size at metamorphosis could affect the survivorship of individuals during the first winter or time to reproduction as an adult (Semlitsch et al. 1988). These effects could impact recruitment rates and population size over longer periods of time.

Direct effects to habitat include reduction in shading, damage to riparian cover and streambanks, and chemical contamination. Salvage logging would remove trees from

riparian areas within the project area. The consequent impact to habitat is not known, but it could have positive or neutral benefit to the riparian habitat. Since upland habitat suitability is partially determined by adequate sunlight reaching the stream (Federal Register 2013), there could be a beneficial effect to upland habitat through the removal of some canopy cover and increasing basking habitat. However, the net effect of salvaging dead trees may not be very big because the dead trees do not provide much shade, thereby making the effect somewhat neutral. The operation of equipment can potentially damage cover in upland riparian habitats as vehicles crush vegetation and displace large woody debris. The loss of cover could negatively impact the ability of SNYLF to thermoregulate, forage, or hide from predators. Equipment could also crush partially decayed logs and reduce potential refuge habitat under the log. The consequences of the loss of cover provided by riparian vegetation would be 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 vegetation would likely regrow within a year. The proposed action includes the use of a registered borate compound (example, Sporax® and hereafter referred to as Sporax®) to limit the spread of fungal disease to recently cut trees/stumps. Stump treatments are unlikely to harm aquatic animals because the method of application and project design measures would limit the potential for adverse acute and chronic exposures. A risk assessment was prepared for the project to address potential exposure scenarios (acute accidental, acute non-accidental, and chronic) for the application of the borate compound.

Under the acute accidental spill scenario, a direct spill of 25 pounds of Sporax® into a small pond (1,000 cubic meters), there would be an exceedance of the established threshold of concern. The threshold is a “no observable effects concentration”, or NOEC, which is set at 1.0 milligrams per liter and equivalent to 1.0 part per million. The modeled concentrations of spilled chemical in water would be 1.3 milligrams per liter which indicates the threshold would be slightly exceeded. This exceedance suggests a risk of impact to individuals is possible, but the risk of mortality or significant injury is very low when compared to the mortality endpoint (lethal dose 50) of 233 milligrams per liter. The risk of an accidental spill of this magnitude is considered to be an unlikely occurrence because applicators typically carry amounts less than 5 pounds at a time. However, should a spill occur in a smaller pond or pool in an intermittent stream, the level of concern for amphibians could be exceeded. However, if only one or a few individuals are affected, we do not expect this to have an effect on population persistence. Additional water quality BMPs would be applied to this activity to limit the risk of chemical entering any aquatic feature including no application when rain is falling or when rain is likely (greater than 50 percent chance) that day, or within 10 feet of surface water.

The MRs proposed for the project would effectively mitigate the direct effects to habitat. These MRs include limiting the distance to streams for equipment operation and limiting the distance to stream and timing of Sporax application.

Indirect effects to habitat primarily include increased sedimentation of aquatic habitats, the reduction in large woody debris from streams and riparian areas, and reduction in

streamflow. There could be an increased rate of sediment delivery to the streams following roadside hazard abatement, salvage logging, machine piling, and pile burning. Of the four activities, salvage logging and machine piling are assumed to have the greater potential for effect. Salvage logging would create soil disturbance and generate a skid trail network, conditions conducive to increased erosion. Skid trails in post-fire environments tend to yield greater quantities of sediment than undisturbed areas and yield increased sediment for a longer period of time (Robichaud et al. 2011). The longer duration of erosion from skid trails is due to the lasting effects of soil compaction and machinery-created disturbance negatively affecting the recovery of ground cover, especially vegetation, on the trails (Robichaud et al. 2011). Primary and secondary skid trails have the most passes by skidders and these trails are most likely to have detrimental soil compaction. Machine piling would result in broad scale soil disturbance which is prone to erosion if adequate soil cover is not maintained. The primary difference between the two activities is that machine piling with low ground pressure equipment does not create a network of compacted trails because the tracked vehicles typically do not make repeated passes on the same trail.

The roadside hazard tree removal has a potential for increasing sediment delivery to aquatic systems because ground based equipment is used and the logs are dragged along the ground, both creating soil disturbance. However, the potential for biologically important levels of sedimentation is low because the area affected is limited (200 feet on either side of the road), there is no skid trail network, and the trees are felled away from the stream so that they can be endlined (pulled by then end of the log furthest away from the stream) by the skidder which limits operation close to the stream. 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).

The primary MRs that would reduce the potential for erosion and sediment delivery from equipment operation include properly designing and locating skid trails, limiting the operation of equipment to periods when soil strength is high enough to resist compaction, subsoiling primary and secondary skid trails following harvest, and maintaining or increasing soil cover to be consistent with the Forest Plan. MRs are also applied to burn piles and address pile location, ground cover during machine piling, and burning in riparian areas.

Effective implementation of the project would require a variety of road actions to make the roads accessible and durable to the vehicle traffic created by the project. Road actions include reconstruction and maintenance of the surface and drainage structures, reopening closed roads, creating temporary roads, construction of new roads, and creation of skid zones. Reconstruction and maintenance actions include the improvement of the road surface (blading/grading), installation or maintenance of drainage structures, minor widening or realignment to permit the passage of equipment, and removal of brush from the road's edge. Some roads within the project area are designated as maintenance level

1, meaning they are currently closed to vehicle traffic, but have been retained and can be reopened for administrative access. Many of these roads are currently impassable, so the actions to reopen the roads would include clearing vegetation from the road prism, improving the road surface to allow equipment access, and installing culverts or other drainage structures (example, rolling dips) as necessary. Upon project completion, access to the road would be blocked and measures would be implemented as needed to reduce sediment delivery from the road surface and fills and reduce the risk of crossing failure and stream diversion. These actions would presumably make these roads "hydrologically neutral" or not likely to contribute sediment or excess runoff to the stream network. Construction of temporary roads may include vegetation clearing, excavation, blading and shaping to provide for safe project access and removal of forest products. New and existing temporary roads would have improvements necessary to attain stabilization of the roadbed and fill slopes, including employing measures such as out-sloping, drainage dips, and water-spreading ditches. Unlike permanent roads, temporary roads would only have the minimal investment and drainage required to minimize resource impacts while providing for safe use and passage of haul vehicles during the short life of the route. Temporary roads are not intended to be a permanent part of the road system and would be decommissioned after use. There would be a limited amount of new road construction. New roads would be designed to engineering standards and according to assigned road management objectives. Expected actions include vegetation clearing, excavation and embankment, blading and shaping, installation of drainage structures, and importing of armoring and surfacing rock material as needed. All new roads would be added to the Forest Transportation System, gated and closed to public vehicular traffic, and would remain available for long-term administrative use for future access and management of NFS lands.

All road actions that improve or create a new road surface have the potential to increase erosion from the road surface and result in sedimentation of aquatic habitats if there is hydrologic connectivity between the road and a stream. For reconstruction, maintenance, and reopening roads, improving the road surface loosens the compaction of the road and makes more fine sediment available to erosion via dust and rain runoff (Coe 2006, Stafford 2011). Stafford (2011) indicated a fairly high rate of connectivity between roads and the stream network; 11 to 30 percent of roads were connected hydrologically to a stream. Reconstruction and maintenance actions are primarily intended to facilitate vehicle use, but limiting hydrologic connectivity to streams is another important aspect of these treatments. Outsloping roads and installing effective water diversion structures can have long term benefits to aquatic systems by reducing the amount of sediment delivered from the road. So, there is a tradeoff for streams with road treatments with increased sediment delivery in the short term (1 to 2 years) and decreased delivery in the long term (greater than 2 years). Temporary roads would be vulnerable to erosion as described above, but these roads are not expected to have long-term effects to aquatic habitats because they would be fully decommissioned after use meaning any culverts or culvert fills would be removed and the road surface would be subsoiled to break up compaction. New roads would require the development of the road prism and installation of culverts and other drainage structures (rolling dips). These roads would remain available to use

for a long period and have the potential to generate sediment that could be delivered to streams.

Management requirements and BMPs are included as part of the implementation of the proposed road actions and are designed to minimize the erosion of the road surface and delivery of sediment to streams.

Salvage logging (including hazard tree removal) would reduce the supply of large woody debris (LWD) in units that encompass or lie immediately adjacent to a stream. The removal of dead trees in riparian areas has the potential to reduce the availability of LWD that falls into the stream or riparian area. While the importance of LWD to SNYLF is unstudied, the general role and function of LWD in creating habitat complexity in a stream may be important to the frog. Therefore, this habitat element could be affected (reduced) by logging. LWD as individual pieces or in aggregates in the channel can create habitat for the frog by trapping sediment upstream and creating a pool downstream of the obstruction to stream flow. Log jams are typically very complex and provide a cool, moist microclimate with ample cavities that can be used as refuge habitat. The pool that is formed downstream of the LWD can be used by all lifestages of the frog, though adequate depth may not be available for successful tadpole rearing. When LWD falls into upland riparian habitats, spaces under the wood can be utilized by post-metamorphic lifestages as a refuge habitat (shade, predation, and desiccation). A MR is in place for recruiting the largest trees along perennial streams in salvage units that would potentially mitigate the overall reduction in LWD recruitment. However, this is considered to be a minimal amount of retention (5 trees per acre) and there would be a very long term (greater than 150 years and up to 300 years for very large trees) reduction in LWD recruitment rate in streamside salvage units.

The drafting of water also has the potential to indirectly affect aquatic habitat through dewatering. As the pumps extract water, the water available to the drafting site and downstream habitats is temporarily reduced. This is considered a short duration, negative impact to habitat because drafting at a maximum rate takes 3 to 5 minutes when streamflow is greater than 2 cubic feet per second. MRs would be implemented to maintain aquatic habitat by dictating the reduction in streamflow.

The analysis of effects to SNYLF is evaluated discretely using the three areas providing suitable habitat identified above (Reynolds Creek area, Kibbie Ridge Area, and Middle Fork Tuolumne River area). The Reynolds Creek and MFTR areas are analyzed at the watershed level, and the Kibbie Ponds and Eleanor Creek areas are analyzed together. This approach was taken because these three areas are more than 10 miles from each other and are within different sub-watersheds of the Tuolumne River.

For all salvage and roadside hazard units, we assume that most of the dead timber would be removed in a single entry by equipment. However, some of the trees that currently have some green needles remaining may succumb to environmental stressors and be eligible for harvest at a later date. These trees could die for up to ten years from the initiation of the project. The number of trees likely to be removed in subsequent entries

is usually restricted to less than 10% of the initial volume and likely much less than the volume of timber initially removed.

Reynolds Creek

Within the range of the frog, approximately 40 acres of salvage harvest (Unit D04B) would occur in the Reynolds Creek watershed, but this unit is greater than 500 feet from stream. Therefore, harvest in this unit would not directly affect aquatic or upland habitat, nor would it affect individuals. This salvage unit is part of a larger unit (345 acres) that extends downstream from the range of the frog. The entire unit is more than 500 feet from stream, thereby constraining the potential for direct impact to habitats or individuals. Fuels treatments would occur as a follow up treatment for submerchantable timber and potential treatments include hand piling, machine piling, jackpot burning, and pile burning. As with the salvage harvest, these operations would not directly affect habitats or individuals.

Roadside hazard trees would be removed from approximately 20 acres within the range of the frog (Map 4e). The number of trees removed from alongside roads is expected to be very low (<20 trees) in the initial treatment because the fire severity was very low to low and tree mortality was less than 50%, and generally below 25%, along the roads. All of the hazard tree acreage is more than 500 feet from the nearest stream providing suitable aquatic habitat. Because no harvest would occur in close proximity to any stream with suitable aquatic habitat, there would be no direct effect to aquatic and upland habitat or to individuals.

Direct effects to individuals, aquatic habitat, and upland habitat would not occur because the harvest units and roadside hazard tree units are greater than 500 feet from the stream. The potential for increased sediment delivery to Reynolds Creek is expected to be minimal. This is because the salvage and machine piling activities would occur more than 500 feet from the creek and high levels of ground cover occur in the low burn severity area downslope of the treatment unit. The high levels of ground cover would be effective at trapping sediment generated by overland flow and preventing the sediment from reaching the channel. Also, management requirements (MRs) and water quality best management practices would be applied to mitigate the potential for off-site sediment loss and subsequent delivery to streams. There would be no reduction in habitat suitability caused by sedimentation from project activities.

Within the range of the frog, proposed road treatments include the reconstruction of 0.9 mile of road, one of which is 0.3 mile (road 3N04Y) and the other 0.6 mile (road 2N05A). The hauling of salvaged materials requires these two road segments be improved to withstand repeated passage by equipment. Actions include the improvement of the road surface (blading/grading), installation or maintenance of drainage structures, minor widening, and removal of brush from the road's edge. Road 3N04Y is currently closed to traffic, would be temporarily reopened, and then closed following project implementation. The proposed road actions would not occur within the 25 meter upland buffer or within 500 feet of Reynolds Creek. There would be no new or temporary road construction or skid zone operation within the range of the frog. Management

requirements and BMPs would be used to reduce erosion and sediment delivery to streams. A combination of distance to the stream and implementation of MRs and BMPs would effectively mitigate the potential sediment effect to habitat from road reconstruction to a negligible level.

Water drafting is proposed at the 3N01 crossing Reynolds Creek, but this is outside of the range of the frog. Since there are fish in this reach of the creek, drafting would cease when streamflows fall below 4 cubic feet per second (cfs). The streamflow in Reynolds Creek typically drops below the 4 cfs in early summer (small watershed and extensive impermeable rock outcrops) making drafting from this site an unlikely occurrence. Sporax® would not be applied within 500 feet of the creek in the range of the frog and direct effects to individuals would not occur from chemical contamination. LWD would not be affected within the range of the frog because there would be no harvest within 500 feet of the stream.

Big and Little Kibbie Ponds: The two ponds and 25 meter upland area lie entirely within a salvage units (O02A and O201B). For Big Kibbie Pond there are no conifers on the east half of pond and most trees to the west are still green. An estimated 20 to 25 trees could be removed between the pond and road (road 1N04Y) with 6 to 10 trees removed from the buffer in year one (based on field review and aerial imagery). Because the fire burned with relatively low severity around the ponds, less than 6 additional trees would be removed in subsequent years as they die from fire-related stress. Unit O201B is a deer forage unit where biomassing would be used to reduce standing dead timber and encourage forage growth. This unit is on the east side of the pond and the hill slopes rapidly toward Lake Eleanor. Activity in this unit is unlikely to impact Big Kibbie Pond because there are extensive rock outcrops which would prohibit the operation of equipment.

Since the pond is considered to be unoccupied, there would be no direct or indirect effects to individuals. There is a very low potential for sedimentation to adversely affect the pond (reduce the depth) because there would be a limited amount of harvest surrounding the ponds which means limited soil disturbance and no detrimental compaction of soils in skid trails (no more than two passes by skidders). Also, the eastern edge of the pond (where the merchantable trees are) slopes away from the pond toward forest road 1N04Y and sediment would not enter the pond. Because fire-killed trees would be salvaged, there would be a moderate impact to LWD recruitment on the east side of the pond. The effect of the salvage would result in a limitation in the recruitment of LWD in upland habitat for more than 50 years or until additional trees die from natural causes.

For Little Kibbie Pond, fire severity was higher and approximately 70 percent of the trees surrounding the pond and within the 25 meter upland habitat area were killed by the fire. There could be activity all around the pond, but sediment delivery to the pond is expected to be low because the slopes immediately adjacent to the pond (within 50 feet) are gentle (less than 5 percent). As with Big Kibbie Pond, because the pond is considered to be unoccupied, there would be no direct or indirect effects to individuals. Sediment is

unlikely to be transported across this low gradient area and high levels of ground cover would help retain soil on the hillslope. The amount of sediment likely to enter the pond is less than 5 tons and this would have negligible effect on the total volume of the pond when full. As noted previously, this pond tends to become dry in less than average precipitation years, probably due to limited watershed area and location on a lateral glacial moraine, and this amount of sediment would not affect the suitability of this non-breeding aquatic habitat. The salvage logging would greatly reduce LWD availability for cover in the upland habitat. This effect is expected to last for more than 50 years or until regenerating conifers become large enough to provide this type of habitat element.
For both ponds, road 1N04Y would be reconstructed as part of the proposed action. This would affect approximately one mile of road within a mile of the ponds. However, these roads are not hydrologically connected to either pond and any erosion from the roads would not affect the volume of either pond. Approximately 5 acres of roadside hazard tree removal would occur within 0.5 mile of the ponds, but the area is more than 500 feet from either pond. As with road 1N04Y, any erosion from project activities would not be delivered to the ponds.

Sporax® could be applied to stumps in close proximity to the ponds. However, the risk of contamination of water is considered to be very low due to MR and BMPs as identified under Reynolds Creek.

There are no fuels treatments planned for either salvage unit. No new or temporary roads would be constructed within one mile of the two ponds. Water drafting would not occur from these ponds. Therefore, no direct or indirect effects to habitat would result from these actions.

An additional MR was developed to provide protection to western pond turtles that occupy the ponds. This MR would not allow the operation of equipment within ¼ mile of the pond from June 1 to July 15 (to protect nesting turtles) or when surface water is not present in the ponds. This would prevent direct impacts to individuals if present.

<u>Eleanor Creek</u>
Approximately 160 acres of salvage would occur in two units (Unit O201B and O02A) within the range of the frog in the Eleanor Creek watershed downstream of Lake Eleanor. This area includes approximately 2.5 acres of upland habitat. There is a relatively dense stand of small dead conifers in Unit O02A, but relatively little vegetation in Unit O201B. As noted under Big Kibbie Pond, Unit O201B is a deer forage unit and biomassing would occur. However, a review of the aerial imagery indicates very little vegetation close to the creek and within the 25 meter buffer. It is unlikely that biomassing would occur close to the creek, but there would be soil disturbance if equipment does operate within the buffer.

As noted earlier, this section of stream is not likely to be occupied by SNYLF because of a long-term (more than 80 years), self-sustaining fish population and the presence of the dam forming Eleanor Lake. The section of creek on STF lands is also below the listed elevation range of the species (Federal Register 2013), approximately 1,000 feet below

the elevation of any historic occurrence of the SNYLF on the forest, and almost 2,000 feet lower than any extant population on the forest. Direct or indirect effects to individuals are unlikely to occur based on probable lack of occupancy. Operations in Unit O02A could produce sediment to Eleanor Creek, but the relatively low gradient hillslopes near the creek would limit sediment delivery to the creek. Applicable MRs and BMPs would be applied to the riparian conservation area of Eleanor Creek (300 feet from the edge of the water). Also, the annual spill that occurs from Lake Eleanor would be sufficient to maintain deep water habitat and would flush project-generated sediment from this portion of the stream within 2 years of project implementation in this area. Management requirements and BMPs would be applied to the units and riparian areas along Eleanor Creek to minimize sediment delivery to the stream. There would be no change in habitat suitability caused by project activities.

Approximately 0.6 mile of road reconstruction would occur within the range of the frog. Because the road is over 1,000 feet from Eleanor Creek, there would be very little measurable sediment delivery to the creek from this activity. This activity would not affect suitable aquatic habitat. The harvest in Unit O02A would affect less than 0.25 acre of upland habitat. The effect would be a reduction in LWD in the upland habitat affecting only the eastern side of the creek. This loss of LWD would be a long-term reduction in objects providing overhead cover for over 50 years. Some refuge and cover habitat would be maintained in the upland habitat affected by salvage and provided by high levels of boulders and rock outcrops. As with the habitats previously discussed, there is a risk of water contamination from the application of Sporax® in the riparian area. MRs should effectively limit the risk of contamination of surface waters and the minimum flow would aid in the rapid downstream dispersal of any spilled material. Within the range of the frog, there would be no roadside hazard tree removal, fuels treatments, or water drafting, and new or temporary roads would not be constructed. These activities would not affect aquatic or upland habitats or individuals.

Middle Fork Tuolumne River

Approximately 114 acres of salvage harvest would occur in the range of the frog within the MFTR watershed (Unit Q09 – 18 acres, Unit Q08 – 42 acres, Q14A – 82 acres). Approximately 7 acres of upland habitat adjacent to the mainstem MFTR would be affected by salvage harvest operations in Units Q09 and Q08. Salvage would affect approximately 33 percent of the total amount of upland habitat available along the MFTR within the range of the frog. Unit Q09 would be harvested using ground based equipment while Q08 would be harvested using skyline methods. Skyline harvest does not use skidders thereby eliminating the skid trail network. This logging system typically results in much less ground disturbance and soil displacement and is less prone to erosion. However, this method does produce ruts parallel with the hillslope because one end of the log is dragged along the ground. Management requirements specific to skyline units would be applied in addition to all other MRs and BMPs for salvage operations in the unit and riparian areas.

Fuels reduction actions would occur in all three units following salvage and the activities include hand piling, machine piling, grapple piling, and pile burning. Approximately 119

acres of roadside hazard tree removal would occur within the MFTR watershed within the range of the frog, including approximately 3 acres in upland areas along intermittent streams. The proposed action would also require the maintenance or reconstruction of approximately 3 miles of road within the range of the frog and the application of Sporax® to the stumps of cut trees. With the exception of the Sporax® treatment, all activities identified above have the potential to cause soil disturbance (either compaction or displacement) which is conducive to erosion. Some sediment is expected to enter the MFTR following project implementation, but the relative impact of this sedimentation to the MFTR is expected to be relatively minor and of short duration. As with all project activities, MRs and BMPs would mitigate the extent of sediment delivery. Also, the MFTR has a relatively large watershed above the project activities (over 31,000 acres) that is in the snow zone where the hydrology of the watershed is driven by snowmelt and runoff. In average precipitation years, the peak discharge of the river would be adequate to diminish the immediate impacts of project-related sediment. It should be noted that large volumes of sediment are likely to be transported and affect SNYLF habitat in the MFTR in the next 2 to 5 years because much of the watershed was burned at moderate and high severity. As such, it would be very difficult to separate project-related sedimentation from fire-related sedimentation. The recovery of vegetation, soil cover, and soil hydrophobicity should occur within this time period and erosion rates should decrease and approach pre-fire rates within this time frame (Gresswell 1999, Neary et al. 2005). Within the upland areas affected by salvage and fuel reduction, the supply of instream and riparian LWD would be reduced for an extended period of time. The impact of the instream reduction would be less than the riparian effect because the watershed above the salvage units will remain unharvested and LWD supply should be high in the next 20 years.

No new or temporary roads would be constructed in the range of the frog and no water sources were identified for the MFTR in this range.

Direct impacts to individuals are unlikely to occur in the MFTR area because there is a very low likelihood of occupancy by the frog. This is because there has been a self-sustaining population of trout for close to or over 100 years, rivers as large as the MFTR are atypical of sites occupied by the SNYLF, and there are no other logical suitable breeding habitats within several miles of the project area. Project activities would impact riparian habitats directly and indirectly with the removal of timber from within upland habitat and the potential for sediment delivery affecting the river from salvage areas. With the implementation of MRs and BMPs, the amount of sediment delivered to channels would be minimized, but sedimentation could slightly reduce pool volume or reduce the interstitial spaces in slow water habitats (especially edge waters). The reduction in pool volume would not significantly affect the persistence of the water or the ability of the river to provide suitable aquatic habitat for any life stage. The extent of LWD loss from upland habitat would affect a minor portion of the available habitat and MRs would ensure an adequate amount of LWD would be available in the future. In all, project activities would not change the suitability of aquatic habitats and would slightly reduce the overall suitability of upland habitat through the loss of LWD.

Foothill yellow-legged frog

Roadside Hazard and Salvage

There is no potential for direct effects to the FYLF in the following occupied locations: Basin, Drew, Grapevine, and Hunter Creeks, and North Fork Tuolumne and main Tuolumne Rivers. Proposed activity location relative to the potential habitat in the creek channel and Table 11 show no project related activity (hazard tree removal, salvage, road treatments) is in close proximity to any of these six streams occupied by the frog. There is no potential for direct effect at the following streams providing suitable habitat for the FYLF: Adams, Alder, Bear Springs, Quilty and Russell Creeks, and Unnamed Clavey Tributary 2. No project activities would occur in close proximity to the streams which negates the potential for direct effect.

Table 11. Amount of buffer, percentage of watershed area affected, and miles of road treatments in foothill yellow-legged frog suitable habitat for Alternative 1.

Watershed (5th level Hydrologic Unit Code)	**Stream name**	**Percent of FYLF watershed area treated, hazard tree and salvage units combined**	**Acres of FYLF buffer affected**			**Road Treatments (miles by treatment type)**			
			Hazard tree	Salvage	Percent of total	Recon-struct	Maintain	New	Temporary
Tuolumne River	Tuolumne River								
	Alder Cr.	10	5	0	4	0.8	2.5	0	0
	Corral Cr.	58	2	81	35	14.8	5	0.5	0
	Drew Cr.	12	12	0.4	11	0.5	4.5	0.1	1.1
	Grapevine Cr.	18	29	0	11	0.7	17.4	0	0
	Indian Cr.	2	1	0	less than 1	0	2.2	0	0
	Jawbone Cr.	25	5	46	14	18.5	8.8	0.2	3.4
Middle Fork Tuolumne River	Middle Fork Tuolumne River	17	22	255	46	58.3	12.5	0	5.3
North Fork Tuolumne River	North Fork Tuolumne River	2	0	0	0	0.4	22.7	0	0
	Basin Cr.	1	0	0	0	0.4	2.1	0	0
	Hunter Cr.	9	0	0	0	0	19.9	0	0
South Fork Tuolumne River	South Fork Tuolumne River	38	30	140	24	76.6	26.8	1.6	2.7
Cherry Creek	Cherry Cr.	11	8	67	18	34.6	9.9	0	1.0
	Eleanor Cr.	1	0	12	22	2.5	0	0	0
	Granite Cr.	27	2	50	36	12.4	1.1	0	0.1
Clavey River	Clavey River								
	Reed Cr.	20	1	49	49	25.4	17.8	0.2	2.2
	Adams Gulch	18	0	0	0	1.6	1.4	0	0
	Bear Springs Cr.	18	9	0.1	20	10	0.7	0	0
	Bull Meadow Cr.	36	5	1	8	3.9	0.7	0	0.8
	Indian	19	3	2	25	1.4	0.1	0	0

Watershed (5th level Hydrologic Unit Code)	Stream name	Percent of FYLF watershed area treated, hazard tree and salvage units combined	Acres of FYLF buffer affected			Road Treatments (miles by treatment type)			
			Hazard tree	Salvage	Percent of total	Recon-struct	Maintain	New	Temporary
	Springs Cr.								
	Quilty Cr.	5	0	0	0	0.1	1.1	0	0
	Unnamed Tributary 1	16	3	0	8	0	2.9	0	0
	Unnamed Tributary 2	24	0	0	0	0	2.5	0	0
	Unnamed Tributary 3	69	0	26	46	11	0	0	0
	Unnamed Tributary 4	43	3	0	13	2	1.7	0	0
	Unnamed Tributary 5	43	7	8	37	2.2	2.7	0	0
	Cottonwood Cr.	31	0	3	5	21.4	7.2	0	0
	Russell Cr.	30	0	0	0	2.2	1	0	0
North Fork Merced River	North Fork Merced River	2	22	18	less than 0.1	11.6	11.8	0	0.3
	Bull Cr.	2	5	0	less than 0.1	0.5	5.5	0	0
	Deer Lick Cr.	8	4	13	7	3.4	2.3	0	0.2
	Moore Cr.	4	5	5	3	1.6	4.1	0	1
	Scott Cr.	22	2	0	8	3.6	3.4	0	0

Based on the limited amount of habitat affected by project activities, Table 7 shows there is a very low risk of direct effect to the following occupied sites because there is very little project activity in the 30-meter buffer. These sites include Bull, Bull Meadow, Drew, Grapevine, and Moore Creeks, and the Clavey and North Fork Merced Rivers. The hazard tree areas and roads are at the upper headwaters of Bull, Drew, Grapevine, and Moore Creeks and the North Fork Merced River. Even though these streams were buffered as suitable habitat, there is a negligible chance of occupancy. Within Bull Meadow Creek watershed, salvage unit L206, a plantation from the 1987 fire, is a proposed deer forage unit. A review of the post-fire aerial imagery indicates low mortality of trees along the stream. A road on the east side of the stream would have hazard trees removed, but imagery indicates limited mortality between the stream and road. Only roadside hazard tree removal would occur along 1N01 at the bridge crossing of the Clavey River. This is outside of the merchantable conifer elevation and the hazard trees are likely to be oaks. If the oaks are cut down the steep bank, there is a very low chance that they could fall to the river over 100 feet away and directly affect an individual frog. However, this is considered to be an unlikely occurrence as the fallers would likely leave the tree close to the road for firewood. The river is far below the road and there is negligible chance for physical disturbance unless the tree falls down to the river.

Direct effects would be a low risk at the following streams (occupancy unknown) because of the limited amount of activity within the buffer as shown in Table 7 or the hazard tree and salvage actions would occur along stream segments with very low habitat suitability. These streams include Cottonwood, Deer Lick, Eleanor, and Indian Creeks, and Clavey River Tributaries 1, 4, and 5. At Deer Lick Creek and Clavey River Tributaries 1 and 5, the roadside hazard tree and salvage units are at the upper headwaters of the streams and habitat suitability is very low if at all suitable. For Clavey River Tributary 4 and Indian Creek, aerial imagery shows very little mortality to conifers at the road crossing. Independently, the very low suitability habitat and low number of dead trees make the risk of a direct effect occurring very low.

A moderate risk could occur to individuals at the following locations: Cherry and Indian Springs Creeks. Table 7 shows 75 acres of salvage actions in the Cherry Creek watershed, but 52 acres alone are in Granite Creek which is discussed immediately below. The 23 acres of buffer treated is at the upper elevation limit established for the frog; therefore, the potential for occupancy is very low, especially in a relatively large stream like Cherry Creek. The level of activity in the buffer does pose a risk for injury, disturbance or mortality in these helicopter salvage units (O3, O6, O7 and P201), but the risk may be slightly lower because ground-based equipment would not be operating in the units. Within the Indian Springs watershed, a salvage unit runs along the north side of the creek at a distance of approximately 1,200 feet. This site has known occupancy by FYLF and low numbers of frogs disperse from the Clavey River breeding sites to this stream. Direct effects to individuals are plausible at Indian Springs. A management requirement mitigates some of the direct effects (injury and mortality) by having timber directionally felled away from the stream. Physical disturbance is probably the most likely effect to individuals and the disturbance could last up to three weeks at the 11-acre unit. Due to the almost complete tree mortality in this unit, it is likely that there would be only one salvage entry.

A high risk of direct effect to individual FYLF could occur for the following streams: Corral, Granite, Jawbone, Reed, Middle and South Fork Tuolumne Rivers. The level of risk is simply associated with the amount of activity within FYLF buffers (Table 11). Due to the high levels of activity close to streams, the risk of injury, mortality, and physical disturbance would increase. Although there is a management requirement to directionally fall trees away from the stream to limit injury/mortality, a considerable amount of machinery would operate in close proximity to the streams. The occupancy status of these six streams is unknown, but occupancy is assumed to occur in order to allow for disclosure of impact. If individuals are killed, a minor impact to population status could occur because all populations are assumed to be small. The number of reproducing individuals could be decreased for up to two years at the localized breeding site scale. The elevated risk of individual mortality would not be likely to result in a localized extinction of a population or subpopulation. The likely outcome of this extensive operation close to streams is increased physical disturbance associated with equipment and forest workers in close proximity to the streams. As with Indian Springs, the disturbance could last up to four weeks (likely 2 to 3). Repeated disturbance could affect basking or foraging and/or increased stress, with a low to moderate risk of temporarily reducing physiological fitness (body condition).

The primary anticipated indirect effect is the increase of sediment delivery to the streams following roadside hazard abatement and salvage logging. Of the two activities, salvaging is assumed to have the greater potential effect because it would generate a larger skid trail network than the area immediately within the 200-foot hazard tree buffer along roads. Skid trails tend to yield greater quantities of sediment than undisturbed areas and yield increased sediment for a longer period of time (Robichaud et al. 2011). The longer duration of erosion from skid trails is due to the machinery created disturbance negatively affecting the recovery of ground cover, especially vegetation, on the trails (Robichaud et al. 2011).

The extent of salvaging in a watershed was the basis for estimating the potential for increased sediment and is represented as proportion of watershed area treated in Table 7. Additional consideration was given to the amount of buffer treated. The closer the activity is to a stream, the shorter the distance for runoff to travel, and the greater the likelihood that sediment is delivered to the stream. The logging system proposed (tractor, skyline, and helicopter) in an affected watershed was also considered because helicopter logging results in much less ground disturbance than ground-based logging. The lower levels of ground disturbance translate into lower erosion rates and less sediment routed to streams. A longer discussion of anticipated erosion effects from salvage logging is provided in the Soils and Watershed sections. The risk categories follow those used for direct effects and are low, moderate, and high. It should be noted that erosion and sediment modeling was completed for post-fire and post-project implementation for each alternative and this modeling showed very little difference in erosion rates or sediment yield. The modeling indicated broad scale decreases in erosion rates that were attributable to increased ground cover from salvage logging in high soil burn severity units (non-merchantable material is left behind).

For streams in the low category (less than 15 percent of watershed area affected), there would be negligible to very minor increases in fine sediments. These fine sediments would mainly affect slow water habitats found in low gradient reaches (less than 2 percent), along the margins of the stream, and in pools. In these watersheds, it may not be possible to differentiate between post-fire erosion and treatment related sediment. This type of habitat impact would not affect habitat suitability for any life stage or the ability of a FYLF population to persist. Streams in the low category include Alder, Basin, Cherry, Deer Lick, Eleanor, Hunter, Indian, Moore, and Quilty Creeks and the Clavey, Tuolumne, and North Fork Merced Rivers.

In the moderate category (15-25 percent of watershed area affected), there would be minor increases in sediment from treated areas. For some reaches in the affected watersheds, it would be possible to differentiate the project related sediment from the post-fire erosion and the spatial extent of the effect on habitat would be localized (up to several hundred square feet below the deposition point). At the smaller reach scale (small streams within a watershed), there could be moderate levels of sediment affecting pool volume or reducing other deeper water habitats (less than 50 percent reduction in volume), but adequate depth should be maintained for individuals needing refuge habitat. Breeding habitat in larger streams could have detectable increases in sediment, but there should be limited impairment of the capability of the habitat to allow for eggmass to tadpole to metamorphosis development. The primary observable change in habitat at

breeding sites would be a reduction in the spaces between larger stream substrates which would reduce the abundance and availability of escape habitat. Also, the increase in fine sediments could partially cover large substrates (large gravel to cobble sized) and limit the amount of foraging habitat on the substrates (tadpoles scrape or suck algae from the surface of rocks). There would be a discountable to minor effect on adult and sub-adult habitat in general aquatic habitat because the small amounts of sediment would not substantially reduce habitat suitability. Adult and sub-adults would still have ample deep water habitat to escape a perceived predation attempt. Streams in the moderate category include Adams, Bear Springs, Clavey River Tributaries 1 and 2, Drew, Grapevine, Indian Springs, and Scott Creek, and the Middle and North Fork Tuolumne Rivers.

For the remaining streams (Bull Meadow, Clavey River Tributaries 3-5, Corral, Cottonwood, Granite, Jawbone, Reed, and Russell Creeks and the South Fork Tuolumne River) there would generally be minor sedimentation at the stream scale and moderate sedimentation of localized habitats. Moderate impact at the local scale would mean a less than 30 percent reduction in volume of deep water habitats, widespread streambed sedimentation (less than 1 inch deep), and temporary reduction of shallow water habitats. Small, low gradient streams would see the greatest level of impact, while higher gradient sections of larger streams would effectively transport this sediment. The effective transport of sediment from some stream reaches would insure the availability of patches of high suitability habitat.

For the moderate and high watershed response categories, the duration of increased project-related sediment would be one to two years, and it may be difficult to differentiate between the post-fire erosion and the treatment related sediment at a watershed scale in the second year. Any repeated entries to remove additional dead material would not be expected to generate detectable sediment because there would be a limited skid trail network and few equipment passes on the skid trails limiting the extent of compaction.

Road Management

The proposed action would include several types of road management activities including maintenance and reconstruction. All action alternatives would propose the construction of new and temporary roads to access salvage units. These actions and activities are further detailed in the Transportation section of this document.

Table 11 shows the types and mileage of road system related actions proposed under this alternative. Several factors determine the extent to which the road actions could affect aquatic habitats, including, but not limited to, the degree of connectivity to a stream or drainage network, approach angle of the road near the stream, spacing of water diversion structures, level of outsloping of the road surface, erodibility of the road surface (soil type), and road surface type. Given the short timeframe allowed for the preparation of this document, extensive field review of the road-stream connectivity was not possible. As such, this analysis lacks site-specificity and instead relies on a generalized approach using the 1) amount of activity in close proximity to streams and 2) total number of miles of road treated in each watershed. A miles per acre calculation was considered for analysis, but this type of simple averaging was not considered to be an accurate indicator of potential effect because road density (and thus, treatment intensity) varied

considerably in any given watershed. The FYLF buffer (30 meters) was used as an indicator of road activity close to streams which includes the road surface area most likely to deliver sediment directly to a stream. The exceptions to this rule were the new and temporary road construction actions.

Road maintenance and reconstruction are similar treatments, but reconstruction typically includes a major reworking of the road surface and can include actions outside of the existing road prism. Both activities include the reworking of the road surface, typically with a road grader or other machine with a blade. This action loosens the compaction of the road surface and makes more fine sediment available to erosion via dust and rain runoff (Coe 2006, Stafford 2011). Stafford (2011) indicated a fairly high rate of connectivity between roads and the stream network; 11-30 percent of roads were connected hydrologically to a stream. Reconstruction and maintenance actions are primarily intended to facilitate vehicle use, but limiting hydrologic connectivity to streams is another important aspect of these treatments. Outsloping roads and installing effective water diversion structures can have long term benefits to aquatic systems by reducing the amount of sediment delivered from the road. So, there is a tradeoff for streams with road treatments with increased sediment delivery in the short term (1-2 years) and decreased delivery in the long term (greater than 2 years). Since the road treatments would occur prior to or during salvage operations in a unit, the sediment from the roads would be expected to combine with sediment generated from salvaging for up to two years.

Relatively little to no road-related sediment would be expected in the following FYLF watersheds: Adams, Alder, Basin, Bull, Clavey Tributaries 1, 2, and 4, Deer Lick, Eleanor, Indian, Indian Springs, Moore, Quilty, Russell, and Scott Creeks, and the North Fork Merced and Tuolumne Rivers. Sediment from maintenance and reconstruction should have no detectable effect on any habitat required by the FYLF. Minor amounts of road treatment related sediment would be expected in Bear Springs, Bull Meadow, Clavey Tributary 3, Cottonwood, Granite, Grapevine, Hunter, and Jawbone Creeks. Effects would be primarily localized and noticeable downstream of road crossings, and, depending on stream size and gradient at the crossing, could affect and area of less than 10 square feet to 100 square feet. In the remaining streams (Cherry, Clavey Tributary 5, Drew, and Reed Creeks and Middle and South Fork Tuolumne Rivers), there would be more areas with localized effects, especially in smaller tributaries. In all the rivers (Clavey, Tuolumne, Middle, North and South Fork Tuolumne Rivers, and Cherry Creek), sediment from the roads may not be detectable after the first year following road improvement and is unlikely to impair any biological function at these large watershed scales.

Corral Creek and the South Fork Tuolumne River have the most new road construction. The segment of new road in the Corral Creek watershed would cross the creek in the uppermost portion of the watershed and would require the installation of a culvert. Sediment would be anticipated from this crossing and persist for two years as the fill compacts and vegetation grows on the bare ground. Also, excavating the channel to place the culvert would generate sediment. The sediment from the fill and channel disturbance would be detectable for approximately 100 feet downstream. This section of stream does not provide suitable habitat for the FYLF, and the overall gradient of the

channel indicates a high potential for this sediment to be transported out of the system within two or three years. The new road construction in the South Fork watershed would occur in upper watershed of Rush Creek. The road does not appear to cross any perennial or intermittent streams and could have very minor impact to aquatic habitat in Rush Creek. Because this stream is above the elevation range of the species on the Stanislaus, it is unlikely that habitat for FYLF downstream in the South Fork would have a measurable impact on suitability.

Water Sources and Rock Pits

Water sources used for the road management activities and logging have management requirements that would result in minimal adverse direct and indirect effects to the FYLF. Direct impacts to individuals are possible as a result of getting "sucked into" the pump (entrainment) or physical disturbance. If an organism is sucked into the pump, it could sustain physical damage (potentially lethal) or could be transported to an inhospitable location (for example, a road prism during dust abatement). To mitigate the potential for entrainment, Forest Plan Direction requires the use of low velocity intake pumps and a management requirement was developed for the use of a drafting box consisting of small mesh screening (1/4 inch maximum). The low velocity intake pump would allow a tadpole to escape entrainment by swimming away and the drafting box would provide a physical barrier to individuals getting close to the pump intake. The operation of pumps would create noise which has the potential to result in physical disturbance to individuals. Under a maximum water volume drafting scenario, three minutes is needed to fill a 1,000 gallon water tanker, but up to 45 minutes could be required under lower streamflow conditions and is considered to be a worst case scenario. At high streamflow locations, there could be up to 10 disturbances a day and up to three times a day at low streamflow locations. The overall duration of activities could be from April through October, constituting a long-term disturbance factor. This amount of disturbance could be enough to impact physiological well-being at the major river drafting sites. However, none of these locations are known to support populations of the frog.

The extent of impact to habitat includes the gradual reduction in stream flow downstream of the drafting sites. In all cases, aquatic habitats would be maintained in all streams with water sources, but periodic reduction in pool volume or the wetted width of the stream would occur. This could happen up to 10 times daily at heavily used sites and could occur from April through October. The Forest Service water quality handbook places limitations on the rate of water extraction and when sources can be used based on streamflow. The maximum drafting rate is 350 gallons per minute in streams and drafting ceases in fish bearing streams with streamflow under 1.5 cubic feet per second. In non-fish bearing streams, drafting would cease when streamflow drops below 10 gallons per minute. These limitations are fully described in the watershed report prepared for the project.

Seven rock pits are proposed for use and three are within the elevation range of the frog. However, none of the pits are located on or within 750 feet of a stream. Because the rock pits are not connected to or located in close proximity to FYLF habitat, no direct or indirect effects to the FYLF are expected to occur.

Fuels Treatments

Fuels treatments are proposed for the roadside and salvage units to reduce fuel loading created by non-merchantable tree material. This post-salvage material would be piled by hand or machine (bulldozer or grapple). Hand piling does not create any ground disturbance and erosion would not be expected in areas treated in this manner. Dozer piling has the potential for the greatest amount of ground disturbance and erosion. Since the extent of this activity would only occur in the salvage and hazard tree units, the categories of watershed concern relate directly to erosion related to dozer piling. Erosion from the machine treated units would be detectable primarily in the moderate and high response watersheds, with slight impairment of FYLF habitat in the moderate response watersheds and minor, localized impairment of habitat in the high response watersheds.

The proposed treatments (salvage, roadside hazard, road improvement and construction) would have little impact on stream shading or the recovery of obligate riparian vegetation. The trees that would be removed are dead and no longer provide much shade to the stream surface. The actions to remove the dead trees would have little or no reduction in shading. The relative importance of shading to the frog is largely unknown, but as discussed earlier, a mix of shaded conditions is likely optimal for thermoregulation. The recovery of obligate woody riparian vegetation is unlikely to be significantly hindered by salvage and hazard tree removal because equipment would not be operating within the typically narrow riparian zone. The resprouting riparian vegetation may be damaged by falling trees, but further resprouting would limit the duration of this impact to less than a year.

The removal of dead trees in riparian areas has the potential to reduce the availability of LWD that falls into the stream or riparian area. While the importance of LWD to FYLF is unstudied, the general role and function of LWD in creating habitat complexity in a stream may be important to the frog. Therefore, this habitat element could be affected (reduced) by logging. There are requirements for recruiting the largest trees in salvage units that would potentially mitigate the overall reduction in recruitment. However, this is considered to be a minimal amount of retention (5 trees/acre) and there would be a very long term (greater than 150 years and up to 300 years for very large trees) reduction in LWD recruitment rate in streamside salvage units.

FYLF Alternative 1 Summary

In summary, the potential for direct effects to individuals is limited to two sites with known occupancy, Bull Meadow and Indian Springs Creeks, and a couple of sites where occupancy status is uncertain. While individuals could be injured or killed, the likely direct effect is a disturbance of normal behavior which should last no longer than four weeks at any treatment area. The primary adverse indirect effect is sedimentation of aquatic habitat and would be related to hazard tree treatments, salvage logging, machine piling, and road actions. A direct relationship between the amount of watershed area treated/proximity to the stream and the potential for increased sedimentation. The magnitude of effect would be variable, from indistinguishable to moderate sedimentation of slow water habitats in small streams. Larger streams and high gradient reaches should provide enough sediment transporting energy to maintain patches of high suitability habitat. Breeding sites could see minor detrimental effects from this sedimentation in the

form of reduced hiding spaces for tadpoles and small sub-adults and a reduction in the amount of preferred foraging habitat. The sediment generated from project related activities would be expected to affect habitat suitability in some places for up to two years post-treatment, but most sites should remain suitable for all life stages of the frog.

Western pond turtle

The risk of detrimental direct effects to the WPT is higher than for the FYLF because the turtle uses the uplands more extensively during different times of the year. As discussed earlier, the 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 12 provides a description of the amount of area treated by hazard tree and salvage logging activities for this alternative.

Table 12. Amount and percentage of western pond turtle buffer affected in salvage and roadside hazard tree units for Alternative 1.

Watershed (5th level Hydrologic Unit Code)	Stream name	Amount of WPT buffer in salvage units (percent of total buffer area treated)	Amount of WPT buffer in hazard tree units (percent of total buffer area treated)
Tuolumne River	Drew Cr.	30 (3%)	89 (9%)
	Jawbone Cr.	701 (22%)	102 (3%)
	Homestead Pond	18 (20%)	0 (0%)
	Three unnamed ponds	27 (10%)	4 (1%)
Middle Fork Tuolumne River	Middle Fork Tuolumne River	2077 (39%)	304 (6%)
	Abernathy Meadow	66 (50%)	6 (5%)
	Grandfather Pond	11 (13%)	2 2%)
	Mud Lake	21 (18%)	0 (0%)
North Fork Tuolumne River	North Fork Tuolumne River	0 (0%)	411 (2%)
	Basin Cr.	0 (0%)	0 (0%)
	Hunter Cr.	0 (0%)	407 (2%)
South Fork Tuolumne River	South Fork Tuolumne River	1373 (21%)	534 (8%)
Cherry Creek	Cherry Cr.	424 (11%)	61 (2%)
	Eleanor Cr.	97 (16%)	0.1 (less than 1%)
	Big Kibbie Pond	86 (88%)	0 (0%)
	Little Kibbie Pond	54 (60%)	2 (2%)
Clavey River	Reed Cr.	443 (49%)	11 (1%)
	Cottonwood Cr.	29 (5%)	24 (5%)
North Fork Merced River	North Fork Merced River	176 (1%)	491 (3%)
	Bull Cr.	35 (less than 1%)	106 (1%)
	Deer Lick Cr.	42 (2%)	109 (5%)
	Moore Cr.	56 (2%)	60 (2%)

Roadside Hazard and Salvage

There is very low to no risk of direct effect to turtles in the following locations: Basin, Bull, Deer Lick, Hunter, Moore Creeks and the North Fork Merced and Tuolumne

Rivers. In these watersheds, salvage and hazard tree treatment areas are located on headwater reaches where habitat suitability is very low or unsuitable. The WPT needs fairly big pools which these habitats lack.

There is a low risk of adverse direct effect to turtles in the following locations: Cherry, Cottonwood, Drew, Eleanor, and Reed Creeks, and the three unnamed ponds at Yosemite Lakes and Grandfather Pond. At Drew Creek, all of the salvage and roadside treatments are in the upper half of the watershed where the stream only has water during the winter months. During the time when salvage activities would occur, this stream is dry and turtles would be expected to occur in the lower section of stream that retains perennial water. Cherry, Cottonwood, Eleanor, and Reed Creeks are at the upper elevation limit of the WPT in streams on the Forest, and potential for occupancy is low. These sites also retain perennial water and turtles would be expected to be streamside when salvage activities would occur. A review of the aerial imagery for Homestead Pond indicates a limited amount of dead timber to the north, west, and south of the pond and a limited amount of equipment operation would likely occur in these areas (greater than 70 percent of available habitat). There is a higher level of activity to the east of the pond, but the estimated volume of timber is relatively low (less than 15,000 board feet/acre) which suggests a fairly low level of logging activity. The most likely type of direct effect to WPT in these watersheds when water is present would be physical disturbance and the duration would be relatively short (less than 4 weeks) at any given location.

Physical disturbance is likely to impact basking the most, since turtles spend a considerable amount of time in the sun in order to increase body temperature and possibly maintain a healthy carapace (Hammond et al. 1988, Boyer 1965). This behavior is important for metabolism, including the digestion of food and incubation of eggs (Moore and Seigel 2006). The timing and amount of physical disturbance could be important to individuals and have low level population implications. If the disturbance occurs early in the season (March through June) when fertilized eggs are developing in females, there could be a delay in development and, if excessive, nesting attempts could be abandoned for the year when most activities are occurring. The amount (a combination of intensity and duration) of disturbance is important as well because excessive disturbance would result in turtles spending more time in the water or occupying suboptimal habitats that may not provide the physiological benefits of basking in preferred locations. In almost all cases, the duration of disturbance from project implementation is expected to be limited to less than a week at most locations, though the intensity of the duration could be high and impact individuals for the majority of the day light hours. The limited duration of disturbance would have a short-term effect on digestion or egg development, but would not have an appreciable effect on long-term physical well-being, including reproduction. The highly mobile turtle can move up- or downstream to avoid the disturbance and there are some indications that individuals can acclimate to repeated disturbance (Moore and Seigel 2006). Subsequent mentioning of physical disturbance utilizes this discussion of consequences to inform the reader of the anticipated environmental outcome for individual WPT effects.

For WPT habitat in and along Jawbone Creek and the Middle and South Fork Tuolumne Rivers, salvage operations present a moderate risk of direct effect to the WPT, mainly due to the amount of activity that would occur in the 300-meter buffer. At these

locations, turtles may overwinter in the upland from October through April, but logging activity 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. These open areas lack salvageable trees and the risk of direct effect is self-mitigating. In the Middle and South Fork Tuolumne Rivers, a majority of the salvage activity would occur in headwater tributaries and along low order streams (1st and 2nd order) with heavy pre-fire forest that typically provide low to very low suitable aquatic WPT habitat. The risk is decreased simply based on this low habitat suitability. However, for the mainstems of the rivers, salvage logging would occur close to the channel and the potential for physical disturbance is moderate. This disturbance could last up to four weeks at any given salvage unit, but long-term impacts to physical well-being are not expected. For all four locations, the potential for injury or mortality of individuals is low because of the year-long availability of water means the turtle would likely be streamside during operations. The risk increases to moderate in October if logging activities continue late into the year because the turtles move into the upland habitat as the weather gets colder. The level of potential impact at these locations would not be sufficient to affect the long term viability of any existing population.

Abernathy Meadow, Mud Lake, and Grandfather, Big, and Little Kibbie Ponds have the highest potential for direct impact to individuals. At Abernathy Meadow, the turtles move into upland habitats during the summer when the seasonal pond goes dry. Previous radio telemetry tracking of individuals at this location confirms the turtles move into the upland and aestivate until the rainy season fills the pond. Because the turtles could be in the upland during salvage operations, there is a high risk of injury or mortality. The same conditions apply to Big and Little Kibbie Ponds, because these wetlands occasionally go dry (as they were during the Rim Fire) and the WPT would be expected to move into the uplands to aestivate. Because of this consideration, a management requirement was imposed for all action alternatives to prohibit the operation of equipment within ¼ mile of the ponds and meadow if the features are lacking water. This management requirement helps to limit risk of injury and mortality. Also, equipment operation is prohibited within ¼ mile from June through July would help to prevent disturbance to nesting turtles.

Grandfather Pond and Mud Lake tend to retain perennial water and the turtles are expected to remain close to the aquatic habitat during the period when salvage operations would occur close to the ponds. Still, some individuals could make overland journeys to and from Birch Lake at Camp Mather or move into the uplands to aestivate. This would pose a risk of injury or mortality during salvage operations. The overall risk to any one individual is considered to be low, but there would be a moderate to high risk of physical disturbance during salvage operations. The consequence would be a short duration (less than 4 weeks) change in behavior where terrestrial basking would be reduced. This would have a minor impact on physiological fitness, but would not be enough to alter a function like reproductive or overwintering fitness. This means a female would produce eggs as in a typical year and the bodily energy reserves entering winter would be sufficient to get individuals through to spring. No long-term consequences to these populations would be expected.

The primary adverse indirect impact to individuals would be sedimentation of stream habitats. As with the FYLF, the degree of impact is related to the extent of activity, particularly activity in close proximity to the aquatic features. The same categorization used for the FYLF applies to the WPT because the deep water features are important elements for both species. The description of impacts to deep water habitat described for the FYLF applies to the WPT and the reader is encouraged to read the FYLF description. Deep water habitats are important to all life stages of the WPT (except hatchlings) for escaping from disturbance (a perceived predation attempt), foraging, and thermal retreat. Sediment that reduces the volume of a deep water habitat by more than 50 percent is considered excessive and degrades habitat suitability from high to low. In larger streams and rivers (examples, Cherry Creek and Middle Fork Tuolumne River), the energy of the water during annual peak flows is enough to maintain extensive areas of high quality, deep water habitat. For hatchling turtles, excess sediment could fill backwater areas that provide high quality suitable habitat for this life stage. If this occurs, some hatchlings may not find sufficient food resources to keep the hatchling alive during the summer or following winter. This impact to habitat could last for 2-3 years, a low level impact to a population, because population growth could be decreased for several years. This should not affect the persistence of any population, however.

A secondary indirect effect that could affect the WPT is that salvage operations would remove standing dead trees from around the aquatic feature. This impact could be beneficial and detrimental to the WPT. The detriment is that these trees provide good overwintering and aestivation habitat when they fall. Turtles will dig themselves under the logs, which provide protection from predators and a moister microclimate during aestivation. Salvage logging would reduce the short- and long-term recruitment of LWD and reduce habitat suitability from high to moderate or low. Salvage logging would also potentially provide a benefit to the WPT because the removal of the trees would provide open, sunny habitat conducive to nesting. Pre-fire areas with dense overstory reduced the quality and quantity of nesting habitat, but areas with high vegetation mortality now give the WPT ample nesting habitat. Salvaging the dead material would provide a more open ground surface which would allow nestlings to easily navigate to the water.

Another secondary indirect effect associated with salvage operations is the reduction of LWD in aquatic systems (as noted previously for the FYLF). The habitat associations between LWD and the WPT are clearer because LWD provides high quality basking habitat when accessible from the water. Jennings and Hayes (1994) indicate the amount of basking habitat improves over-all habitat quality; therefore, abundant LWD in a stream would enhance habitat quality. The rate of recruitment of LWD from salvaged areas would be greatly reduced in localized areas. However, recruitment from upstream areas that were burned and unsalvaged should maintain relatively high LWD recruitment rates, and a management requirement is in place to retain five pieces of LWD (the largest trees) per acre for riparian areas in salvage units. The retention of this minimum amount of LWD would be beneficial for streamside habitat. The expected reduction in LWD recruitment rate is expected to have a very long term effect (greater than 150 years) and is related to the time when mature forests are re-established on the landscape.

Road Management

The effects of road management activities on the WPT aquatic habitats would be very similar to those discussed for the FYLF.

Water Sources and Rock Pits

The effects associated with using water sources and rock pits is described under the FYLF and the effects to individuals and habitats is very similar to those for the FYLF.

Fuels Treatments

The effects of fuels treatments on the WPT aquatic habitats would be the same as for the FYLF. As with the salvage logging, treatments occurring within the buffer established for the WPT would increase the risk of directly impacting individuals occurring in upland habitats. There is a very low risk of injury and mortality in units using hand piling to treat surface fuels. Physical disturbance is the most likely direct impact and there would little to no adverse impact to an individual's well-being. Units with machine piling would increase the risk of direct impact to relatively high levels because the intensity of operations would likely be high, especially in areas with high levels of mortality in small diameter (non-merchantable) stands. Machine piling would likely occur only in one year and could occur one to five years following the salvage activities. As with the salvaging, low levels of mortality could affect population size for several years and until new individuals enter the population.

Hardhead

As noted earlier, suitable habitat is restricted to the lower reaches of the North Fork Tuolumne and Clavey Rivers and the Tuolumne River to approximately Lumsden Bridge. Because there are very few harvest or roadside units in close proximity to these river sections, there would be no direct effect to hardhead. There is a hazard tree unit along Lumsden Road, but trees would not be felled into the Tuolumne, thereby eliminating the risk of direct effect to any individual.

The indirect effect to hardhead is only related to sediment. Because a very small portion (less than 3 percent) 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. The fine sediment generated in the Hunter Creek watershed would be assimilated by the mainstem of Hunter Creek and then the North Fork Tuolumne above the reach suitable for hardhead. Because the Tuolumne River does not provide suitable breeding habitat for the hardhead (due to regulated streamflow), there would be no indirect impact on spawning habitat suitability. There would be no detectable effect to deep water habitats used by sub-adult and adult fish because the annual peak and base flows in the river are enough to mobilize and redistribute this sediment. There could be 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 would not be sufficient to have much of an effect on pool and deep run habitats.

CUMULATIVE EFFECTS

Salvage harvest 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 has been discussed earlier in this document and this activity has the highest potential to increase erosion and sedimentation rates in a watershed. Livestock grazing is also discussed because the impact of concentrated livestock use in riparian areas (made more sensitive by moderate and high soil burn severity conditions) may have localized impacts to streambanks and the reestablishment of riparian vegetation.

Livestock grazing as a cumulative stressor will be discussed at a general level, because there is uncertainty regarding Forest Service administration of permits for allotments affected by the fire. Livestock may be excluded, partially or fully, from some allotments within the Rim Fire perimeter in 2014. Assuming the Forest Service allows light levels of grazing in portions of the allotments in 2014, 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 percent) where alluvial (or depositional) banks dominate. In steeper gradient reaches, the streambanks tend to be more armored by larger diameter substrates (rocks like cobble and boulder) and resistant to bank shear. These localized areas of streambank disturbance may not have much of an effect at larger watershed scales, but they can influence sedimentation at locally important scales. If livestock are allowed to graze portions of the allotments, a small increase in sedimentation would be expected along low gradient reaches with no discernible increase along higher gradient sections. Table 9 shows the cumulative impact would be unnoticeable for watersheds with limited salvage activity. However, any impact in watersheds with high levels of salvage (greater than 50 percent of watershed or FYLF/WPT buffer, Table 14) could cumulatively contribute to extensive 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 poorly managed livestock can severely affect the recovery of obligate woody and herbaceous riparian species. The rapidly regrowing riparian vegetation is 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. Salvage logging does not generally impair riparian recovery if adequate equipment exclusion zones are maintained, so there may be very little cumulative effect to riparian recovery.

California red-legged frog

Similar to FYLF, WPT, and hardhead, salvage harvest on Forest Service and private land, and livestock grazing were the two types of cumulative effect stressors evaluated for California red-legged frog. Concentrated livestock use in riparian areas (made more sensitive by moderate and high soil burn severity conditions) may have localized impacts to stream banks and the reestablishment of riparian vegetation. The generalized discussion of livestock grazing provided for the FYLF, WPT and hardhead also applies to California red-legged frog. The remaining cumulative effects discussion focuses on salvage harvest on public and private land. Table 13 shows the non-grazing cumulative impacts to CRLF habitat for each specific analysis area.

Table 13. Cumulative impacts to CRLF habitats from non-grazing federal and private actions.

Habitat	Percent of Habitat Affected					
	Alt 1	Alt 1 + CE	Alt 3	Alt 3 + CE	Alt 4	Alt 4 + CE
California red-legged frog						
Birch Lake / Mud Lake (breeding)	0/0	0	0/0	0	0/0	0
Non-Breeding (Per and Int.)	30	35	29	34	29	34
Upland	28	36	28	36	28	36
Drew Creek (breeding)	0	0	0	0	0	0
Miles of Non-Breeding (Per and Int.)	11	25	2	16	2	16
Acres of Upland	10	19	7	17	7	17
Harden Flat (breeding)	0	0	0	0	0	0
Miles of Non-Breeding (Per and Int.)	6	11	6	11	6	11
Acres of Upland	14	32	14	32	14	32
Homestead Pond (breeding)	100	0	71	97	71	97
Miles of Non-Breeding (Per and Int.)	0	5	0	5	0	5
Acres of Upland	9	21	3	15	3	15
Hunter Creek and Ponds (breeding)	0/0	0/5	0/0	0/5	0/0	0/5
Miles of Non-Breeding (Per and Int.)	9	15	9	15	9	15
Acres of Upland	10	16	10	16	10	16

Birch and Mud Lakes

The Rim Fire Hazard Tree project would affect approximately 254 acres of upland habitat along two roads (Evergreen Road and 1S02) and the Peach Growers recreational residence tract. Actions along these roads would not additionally impact suitable breeding and non-breeding aquatic habitat or dispersal habitat between the lakes, but hazard tree reduction along these roads would affect an additional 6 percent of the available upland habitat at this location. Cumulatively, 36 percent of the upland habitat would be impacted by salvage or roadside hazard tree harvest. The increase in activity increases the risk of direct impact to individuals because mechanized equipment would be working in more habitat frogs could be in, increases the risk of sedimentation of non-breeding aquatic habitat, and reduces the amount of LWD available for use by the frog. The removal of hazard trees as described in the Rim Fire Hazard Tree EA would contribute to a long-term decrease in LWD on the landscape and would cause a slight decrease in the suitability of the upland habitat relative to cover. The location of the cumulative actions indicates there is no likelihood that sediment would increase in Mud Lake, and the extensive meadow and lack of defined drainage network suggests that increased sediment delivery would not occur in Birch Lake.

Drew Creek

Within the Drew Creek habitat area there are 11 acres of private land within the Spinning Wheel Emergency Salvage Sale and 369 acres of hazard tree removal from National Forest System lands. None of these actions would directly affect suitable breeding habitat or dispersal habitat, but would affect non-breeding and upland habitats. For the Spinning Wheel sale, this activity is within the Middle Fork Tuolumne River watershed and non-breeding habitat crosses the parcel. This sale would not affect individuals in breeding habitat because it is more than 0.75 mile from Drew Creek. An increase in sediment delivery to the Middle Fork is not likely because the area of the sale is relatively flat (less than 5 percent slope) and sediment transport to the stream should not occur.

Hazard tree removal would occur adjacent to the intermittent section of Drew Creek above the area with suitable breeding habitat and increases in sediment are possible from this activity. This sediment would be additive to the proposed action in this part of the watershed and contribute to impacts to downstream breeding habitat. This sediment should be delivered to the breeding habitat either in the same year as the proposed action or the year before the proposed action. If it occurs with the same year as the proposed action, the expected outcome is a slight reduction in pool volume and fine sediment deposition in other slow water habitats. There would be a slight reduction in tadpole foraging habitat and temporary reduction in refuge habitat found between the streambed substrates. The consequences would be a slight increase in time to metamorphosis for tadpoles and slight increase in predation risk. If the sediment is delivered prior to the actions in Alternative 1, the sediment would have very little impact on habitats within the creek. The sediment would likely be stored in the very low gradient section of stream that traverses the private property at Drew Meadow, making detection of the sediment downstream very difficult. This level of sedimentation would not constitute any level of biological impairment and the habitat suitability would remain unchanged.

Harden Flat Ponds

There are no proposed activities on the private land immediately surrounding the ponds. Within the upland area around the ponds, other actions would impact approximately 306 acres of upland habitat. The Manly Emergency Salvage Sale includes 137 acres on the parcel northwest of the breeding habitats, the Sawmill Emergency Salvage Sale includes 29 acres in the northwest corner of the habitat area, and the Rim Fire Hazard Tree action would affect approximately 140 acres of upland habitat. Proposed activities on the Manly parcel is within the watershed of one of the ponds and could contribute sediment to the pond and cause a reduction in pond volume. This sediment would not be cumulative from actions proposed under Alternative 1 because there are no treatment units within this watershed. Sediment from the portion of the Rim Fire Hazard Tree project along Highway 120 would add to sediment in the pond, but is independent of the effects of the actions proposed in Alternative 1. The salvage harvest in the Manly parcel would not reach the Middle Fork Tuolumne River and would not cumulatively add to sediment in the river. The Sawmill Sale could affect a small non-breeding stream, but there would be no cumulative addition of sediment to this habitat because the actions in Alternative 1 would not occur within this watershed. A portion of the Rim Fire Hazard Tree project would occur along the Harden Flat road and is adjacent to the Middle Fork Tuolumne

River. Small amounts of sediment could enter the stream from this activity in addition to the actions proposed in Alternative 1. Cumulatively, there would be some deposition of sediment in slow water habitats, but this amount of sediment would not effectively impair any biological function of the river. The river has deep water habitat the frog needs for refuge.

All three cumulative actions and the actions in Alternative 1 would cumulatively affect 32 percent of the upland habitat available to the frog. This is a relatively high percentage of the upland area and the risk of direct impacts to individual CRLF would be moderate based on this percentage of habitat disturbed. There would also be a long-term reduction in LWD in these areas and upland habitat suitability would have a minor reduction in suitability based solely on the cover provided by the dead logs.

Homestead Pond

The Rim Fire Hazard Tree project and livestock grazing on the Meyer-Ferretti allotment were the two cumulative actions affecting aquatic habitat in this analysis area. Livestock did not graze the allotment in 2014 and it is uncertain whether grazing will occur in 2015. In this vicinity, livestock use the pond for watering and the meadow area surrounding the pond provides forage for the cows. There is moderate annual trampling of the shoreline of the pond and some increase in sediment occurs as a result of this action. This action has the potential to impact the volume of the pond over a long period of time (greater than 50 years). Livestock grazing does not occur in the non-breeding aquatic habitat in the Tuolumne River but does affect the headwaters of Moore Creek. The impacts to this tributary would not combine with effects from the proposed action because there would be no activity in this watershed.

The roadside hazard tree removal proposed in the Rim Fire Hazard Tree EA would affect approximately 244 acres of upland habitat in the analysis area. Hazard tree removal would occur in close proximity to the pond under the Hetch Hetchy powerlines and would reduce the availability of LWD in upland habitat near the pond. This action would affect approximately 12 percent of the upland area around the pond and would combine with the actions proposed under this alternative to affect approximately 21 percent of the upland habitat. This level of impact would have very minor impact to upland habitat relative to LWD, and the overall suitability of the habitat to support the frog in upland habitat would not be affected.

Hunter Creek and Ponds

Three actions would occur in this analysis area that have the potential to cumulatively affect the CRLF or its habitats and include the Duckwall Emergency Salvage Sale, the Rim Fire Hazard Tree EA, and livestock grazing on the Hunter Creek Allotment. The Duckwall Emergency Salvage Sale includes 480 private acres (4 percent of upland habitat area) and includes 0.4 miles of breeding stream habitat in section 16, Pond 1, and 1.6 miles of non-breeding habitat. The Rim Fire Hazard Tree EA actions would affect an additional 189 acres of upland habitat and includes 0.1 mile of potential non-breeding aquatic habitat. Salvage activities around Pond 1, the breeding habitat in Hunter Creek, and the non-breeding habitat have the potential to injure or kill any red-legged frogs in the area, and would

add cumulatively to the slight possibility of the same effect due to the proposed action within the Hunter Creek watershed.

The salvage and roadside hazard tree removal actions would affect approximately 6 percent of the upland habitat in this analysis area and would combine with the actions proposed under Alternative 1 to affect 15 percent of the upland habitat. The primary anticipated impact is the reduction of LWD which would affect both aquatic and upland habitats. Loss of LWD would occur on 5.1 miles of stream habitat, or 14 percent of the total stream habitat in the area. Salvage operations, and to a lesser degree roadside hazard tree removal, would result in an increased rate of sediment delivery to breeding and non-breeding aquatic habitats. Most of the activity is in the intermittent headwater tributaries and the impacts would be localized, affecting small portions of the tributaries. This sediment would likely not be sufficient to impact the breeding habitat after it has been flushed from the tributaries because it would be well distributed and probably not readily measurable. Sediment would be expected to increase slightly for one to two years, and then be flushed from the system in two to five years.

This analysis area lies entirely within the Hunter Creek grazing allotment. Livestock did graze this allotment in 2014. There are no primary foraging areas adjacent to the stream which effectively limits the extent to which livestock are close to the stream. The livestock do use the breeding and non-breeding aquatic habitats for accessing water and there are localized impacts to streambanks at these access points. Grazing is probably a very minor source of sediment in this stream as determined by stream surveys conducted in the recent past (pre-fire). These surveys indicated very low prevalence of fine sediments in pool and pool tail (slow water) habitats from all sources combined, including livestock grazing and the road system. If patterns of grazing are maintained post-fire, the grazing will continue to contribute very small amounts of sediment to the streams which would combine with other cumulative sources. This sediment should not impair the biological functioning of the creek and suitable habitat for the frog is expected to continue to be available for frogs.

Sierra Nevada yellow-legged frog

Reynolds Creek

Almost the entire Reynolds Creek watershed lies within lands administered by the Forest Service. There is a small parcel (40 acres) of privately owned property located approximately 1.2 miles downstream from the range of the frog. There are no emergency timber harvest plans on file for this parcel. Therefore, no cumulative effects are expected in Reynolds Creek.

Big and Little Kibbie Ponds

The entire watersheds of these two ponds lie entirely within lands administered by the Forest Service. Therefore, there are no cumulative actions that would cumulatively affect these habitats.

Eleanor Creek

The streamflow in Eleanor Creek is regulated by the operation of the dam at Lake Eleanor. The San Francisco Public Utilities Commission completed the dam in 1918 to

provide power and revenue for the subsequent construction of O'Shaughnessy Dam (Hetch Hetchy reservoir) and streamflow below the dam has been altered since that time. There is a conveyance tunnel between Lake Eleanor and Cherry Reservoir (Lake Lloyd) so that water can be diverted for hydroelectric power generation and other purposes. The minimum flow below the dam is 5 cubic feet per second from October through June in all years. The minimum flow increases to 15.5 cfs from July through September. When water is diverted to Cherry Reservoir, the minimum flows required are 5 cfs from November through February, 10 cfs from March 1 through April 14, 20 cfs from April 15 through September 15, and 10 cfs from September 16 through October. Flows below the dam may be annually augmented by spill flow if the reservoir exceeds capacity. When this occurs, the peak flow of the creek downstream of the dam is decreased (compared to inflow to the reservoir) and delayed by several weeks, thereby diverging from a natural flow pattern. This flow pattern, including minimum flows, is conducive to maintaining the self-sustaining trout population in the creek and significantly alters the habitat suitability of Eleanor Creek for SNYLF.

All other lands within the Eleanor Creek watershed are public lands administered by the Forest Service or National Park Service.

Middle Fork Tuolumne River

The entire upper watershed of the MFTR lies within lands administered by Yosemite National Park and there are no private or state lands in the watershed. Therefore, there are no cumulative actions that would cumulatively affect this habitat.

Foothill yellow-legged frog

The remaining cumulative effects discussion is focused on salvage logging (hazard tree and salvaging) on public and private lands. Table 14 indicates 16 streams would not have cumulative effect attributable to salvage logging or hazard tree removal on public or private lands. Four streams (Grapevine, Hunter, and Indian Creeks and the North Fork Tuolumne River) would have small increases in percentage of buffer treated and percentage of watershed area treated, but the amount would be less than 20 percent and 25 percent, respectively. In these four streams the amount of activity in the FYLF buffers and watershed is considered to be relatively low, and there would be no substantial increase in potential for direct and indirect effect. The primary direct effect would be increased disturbance, but the extent of this effect would not have an observable impact to overall well-being of any individual. Also, we would expect to see a very slight, if discernible, increase in sediment delivery to these streams, but the increase would be very small and would not further impair the suitability of habitat for the frog.

Table 14. Percentage of watershed area and foothill yellow-legged frog and western pond turtle buffers affected by salvage activities in Alternative 1 and cumulative sources (public and private).

Watershed and Stream name	**Percent of FYLF buffer affected**		**Percent of watershed area treated**		**Percent of WPT buffer affected**	
	Alternative 1	Alternative 1 + Cumulative	Alternative 1	Alternative 1 + Cumulative	Alternative 1	Alternative 1 + Cumulative
Tuolumne River Watershed HUC 5						
Alder Cr.	4	4	10	10	--	--

Watershed and Stream name	Percent of FYLF buffer affected		Percent of watershed area treated		Percent of WPT buffer affected	
	Alternative 1	Alternative 1 + Cumulative	Alternative 1	Alternative 1 + Cumulative	Alternative 1	Alternative 1 + Cumulative
Corral Cr.	36	78	58	72	--	--
Drew Cr.	17	28	12	29	12	27
Grapevine Cr.	11	18	18	23	--	--
Indian Cr.	1	6	2	4	--	--
Jawbone Cr.	15	43	25	75	25	53
Homestead Pond	--	--	--	--	20	49
Middle Fork Tuolumne River Watershed HUC 5						
Middle Fork Tuolumne River[1]	45	57	48	61	44	57
Abernathy Meadow	--	--	--	--	55	55
Grandfather Pond	--	--	--	--	16	35
Mud Lake	--	--	--	--	18	73
North Fork Tuolumne River HUC 5						
North Fork Tuolumne River	0	2	1	6	2	6
Basin Cr.	0	0	1	5	0	less than 0.1
Hunter Cr.	6	14	9	23	8	19
South Fork Tuolumne River HUC 5						
South Fork Tuolumne River[2]	10	34	36	46	30	39
Unnamed ponds near Yosemite Lakes	--	--	--	--	5	8
Cherry Creek HUC 5						
Cherry Creek	18	34	13	35	13	29
Eleanor Cr.	22	22	1	1	16	16
Big Kibbie Pond	--	--	--	--	88	88
Little Kibbie Pond	--	--	--	--	63	63
Granite Cr.	36	78	27	85	--	--
Clavey River HUC 5						
Reed Cr.	50	54	20	34	50	62
Adams Gulch	0	0	18	36	--	--
Bear Springs Cr.	20	31	18	78	--	--
Bull Meadow Cr.	8	21	36	47	--	--
Indian Springs Cr.	25	25	19	29	--	--
Quilty Cr.	0	0	5	73	--	--
Unnamed Tributary 1	8	8	16	16	--	--
Unnamed Tributary 2	0	0	24	24	--	--
Unnamed Tributary 3	46	50	69	78	--	--
Unnamed Tributary 4	13	13	43	43	--	--
Unnamed Tributary 5	37	37	43	45	--	--
Cottonwood Cr.	5	18	31	43	--	--
Russell Cr.	0	0	30	30	--	--
North Fork Merced River HUC 5						
North Fork Merced River	2	2	10	10	4	4
Bull Cr.	less than 0.1	less than 0.1	2	2	1	1

Watershed and Stream name	Percent of FYLF buffer affected		Percent of watershed area treated		Percent of WPT buffer affected	
	Alternative 1	Alternative 1 + Cumulative	Alternative 1	Alternative 1 + Cumulative	Alternative 1	Alternative 1 + Cumulative
Deer Lick Cr.	7	7	8	8	7	7
Moore Cr.	3	3	4	6	6	7
Scott Cr.	4	4	22	22	--	--

[1]Percentages calculated for the 6th level HUC Lower Middle Fork Tuolumne and not for the 5th level HUC
[2]Percentages calculated for the 6th level Lower South Fork Tuolumne River HUC

The amount of cumulative disturbance within FYLF buffers at Bull Meadow, Drew and Cherry Creeks would be moderate and not exceed 35 percent of the total buffer in the watershed. At Drew Creek, most of the cumulative increase in disturbance would be in the upper watershed where habitat suitability for the FYLF is very low. There would be no increase in direct effect to the FYLF, but the increased activity in the watershed could deliver additional sediment to the stream. The increased buffer affected for Cherry Creek actually reflects the amount of activity in the Granite Creek subwatershed (discussed later). For Cherry Creek, there would be no discernible increase in direct effect to FYLF from cumulative salvage actions.

Four streams, Cottonwood and Reed Creeks and the Middle and South Fork Tuolumne Rivers, would see moderate to large amounts of FYLF buffer or total watershed area treated. Cottonwood and Reed Creeks are at the upper elevation range of the FYLF on the forest, and the risk of direct effect may be mitigated by their location. The cumulative amount of watershed area treated in both of these watersheds is between 34 and 43 percent. This extent is considered to be enough to potentially increase sedimentation to the point where habitat suitability begins to be impaired. The suitable habitat in both streams is near the confluence with the Clavey and the "pour point" of all disturbances in the watershed. Impacts to habitat would include decreased depth in slow water habitats, extensive sedimentation along the margins of the streams, and reduced availability of hiding refuges. Habitat suitability would be reduced from moderate-high to low-moderate. The increased sediment would be expected to last up to three years. This amount and duration of sediment would not be expected to affect the persistence of a FYLF population. Using the cumulative watershed effects (CWE) modeling from the Watershed section of this EIS, the Reed Creek watershed (6th level HUC) would exceed the threshold of concern (TOC) from 2014 through 2017, indicating watershed processes could become increasingly unstable during this period. Lesser, lingering watershed effects could continue for up to two years (through 2019) after receding below the TOC.

The amount of FYLF buffer treated would be relatively high in the Middle (57 percent) and South Fork (34 percent) Tuolumne River watersheds and the risk of direct effect to individuals would increase at a 5th level HUC watershed scale. The primary direct impact would be physical disturbance and the duration of activity in any given area would be approximately four weeks. The cumulative amount of activity in the watersheds would be extensive, affecting between 46 and 61 percent of the total area in the lower 6th level HUC (excludes the area in the upper Middle and South Fork Tuolumne River 6th level HUC). The extent of activity in these watersheds suggests greater increases in sedimentation are possible and impacts to habitat would be more observable. Again, deep water habitats would be reduced in volume and sedimentation would impair a

greater amount of the edge water habitat. These are relatively large streams with high seasonal peak discharges; therefore, some high suitability deep water habitat should be maintained. The additional sediment along the margins of the rivers could affect tadpole habitat by filling the hiding spaces between larger rocks and limiting the availability of foraging habitat. These effects could lead to reduced survivorship from the tadpole stage due to increased predation or lower individual fitness (body condition) due to limited food resources. If adequate energy is not available from a tadpole's body mass, it may not metamorphose or may not metamorphose in a timely manner as to allow the metamorph the opportunity to adequately forage prior to winter. These two consequences could reduce recruitment to populations, resulting in smaller population numbers over the next 3 to 5 years. Using the CWE modeling, the Middle Fork would exceed the TOC from 2014 – 2017, indicating watershed processes could become increasingly unstable during this period. Lesser, lingering watershed effects could continue for up to two years after receding below the TOC.

Cumulative actions in the watersheds of five streams would potentially have significant impacts on habitat suitability. These streams are Bear Springs, Clavey Tributary 3, Corral, Granite, and Jawbone Creeks. In these streams, 31 to 78 percent of the FYLF buffer and 72 to 85 percent of the watershed area would be affected by cumulative actions (Table 14). In these streams, there would be a high risk of direct impacts to individuals and high to very high risk of indirect effects to individuals, populations, and habitat. The amount of buffer treated in these watersheds means extensive equipment operation in close proximity to the streams. While the risk of mortality and injury should remain low due to the flight response of the frog, the potential for physical disturbance is high. Duration of disturbance should be limited to approximately 4 weeks in most locations, but the extent of operations suggests more individuals may be subjected to disturbance. The stress of disturbance may combine with the expected reduction in habitat suitability (less deep water habitat in small streams) and impair individual well-being. The added stress could indirectly lead to increased mortality rates over the first winter, effectively lowering population size.

Habitat suitability would also be significantly reduced from excess sediment and some small stream habitats may be unsuitable for the first year post-logging. Suitability would slowly improve over the next two to three years as the sediment is scoured and transported downstream. The sediment increases may make breeding and tadpole rearing habitats unsuitable in Corral and Jawbone Creeks for up to two years. A loss in reproduction in two or more years would decrease populations and potentially affect the long-term viability of some populations. The two most at-risk populations are in Corral and Jawbone Creeks because the Tuolumne River likely effectively prevents the travel of individuals between watersheds. Isolated populations have a greater risk of extirpation than well-connected populations (Dunham et al. 2003). Therefore, if one of these isolated populations is extirpated, there is a very low likelihood that it would be recolonized within the next 20 to 50 years. For Bear Springs and Clavey Tributary 3, the potential for re-colonization would have a moderate to high likelihood because the FYLF is well distributed along the Clavey. It should be noted that surveys have not detected FYLF at any of these locations, but occupancy is assumed in these streams.

In support of the indirect effects to these streams, the CWE modeling was used and indicated the Corral and Granite Creek watersheds would exceed the TOC from 2014 to 2018, indicating watershed processes could become increasingly unstable during this period. Lesser, lingering watershed effects could continue for two to three years after receding below the TOC (through 2021). CWE modeling was also completed for the Bear Springs and Jawbone Creek watersheds and the TOC would be exceeded for two years, and relatively high equivalent roaded area (ERA) impacts would continue for three additional years.

Western pond turtle

The discussion of cumulative effects to stream habitat for the FYLF 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. The discussion of direct effects for the FYLF applies to the WPT because actions within the FYLF buffer reflect the amount of activity in close proximity to the streams.

As with the FYLF, there would be very little to no cumulative effect to individuals or habitats for Basin, Bull, Deer Lick, Eleanor, Hunter, and Moore Creeks; the North Fork Merced and Tuolumne Rivers; and the unnamed ponds near Yosemite Lakes. This assessment of potential effect is based on the small (or no) change in amount of buffer affected in Alternative 1 and cumulative actions as shown in Table 14 and the location of the actions adding cumulatively to the alternative.

Moderate detrimental cumulative impacts would be expected at Cherry and Drew Creeks and the South Fork Tuolumne River and the magnitude of indirect effect (sedimentation) would impact WPT habitat in the following ways. Moderate sedimentation of deep water habitats would be expected in Drew Creek. If the 2005 Tuolumne Fire is used as a comparative example, high levels of sediment would fill small, shallow pools while the larger, deeper pools found in higher gradient areas would maintain most of their volume. Sediment “lenses” would be evident at the lower end of these larger pools, but the deepest part of the pool would be maintained for escape habitat. The shallow edge water required by hatchlings would be maintained in these larger pools, and the intermittent nature of the stream (in sections) would provide this necessary slow water habitat. The cumulative salvage actions would not occur in the reach occupied by the WPT and no cumulative impact to nesting or overwintering habitat would be expected. The South Fork Tuolumne River and Cherry Creek have sections with high gradient and pool abundance. The water energy in annual peak flows and high gradient sections should maintain more than 50 percent of pool habitat at high suitability levels. The remaining pool habitats would have moderate to high suitability for the WPT.

Moderate to high levels of cumulative impact would be expected at the Middle Fork Tuolumne River, Jawbone Creek, and Reed Creek, similar to that described previously for FYLF. The high overall level of activity in WPT buffers (53 to 62 percent of the buffers affected) suggests a moderate to high likelihood that physical disturbance would occur during salvage activities. The risk is greatest during June and July when females move upland to nest. It is possible that females could abandon nesting in the year salvaging would occur, but a long-term impact to population levels is not expected if only

one year of recruitment is missed. The risk of injury or mortality is considered to be low at these locations because they maintain water during the period of time when salvage operations would occur (April through October). The risk of injury or mortality becomes moderate in October when night temperatures approach freezing and turtles move into the uplands to overwinter. Equipment operation in the uplands following nesting has a very low chance of impacting nests because the nests are typically located in areas with sparse overhead vegetation. These are areas that would typically not be harvested, but patches of open areas could occur in areas with merchantable timber.

The discussion of sediment related impacts to WPT habitat in these three locations is similar to what is described for the FYLF. Most deep water habitats would see moderate impacts (reduced pool volume), while patches of high suitability habitat would be found in the largest pools and in areas with higher stream gradient.

High levels of cumulative disturbance would occur in the WPT buffer areas at Abernathy Meadow (55 percent of buffer affected), Mud Lake (73 percent), Homestead Pond (49 percent), and Big Kibbie (88 percent) and Little Kibbie (63 percent) Ponds (Table 14). The potential for adverse direct effects, mainly physical disturbance, to occur are high during the period when operations occur in these areas and should last for approximately three weeks, but multiple entries into the buffer would be likely for hazard tree removal and salvage logging. This means two periods of disturbance would likely occur during the first year (2014-15), but the intensity and duration of disturbance should not be enough to affect the long-term well-being of individuals. The risk of injury and mortality would also increase at these locations during the summer when the volume of the ponds decreases by greater than 50 percent. The decreased pond volume could trigger an aestivation response and include the departure from the water to the upland habitats or movement between nearby aquatic habitats. If the timing of salvage operations coincides with this movement period, the risk of injury or mortality would increase to moderate levels. Any further loss of individuals from these four locations could effectively suppress population size for 15 years or more. The presence of mostly adult turtles at these locations suggests the recruitment rate of young turtles is very low.

The extent of salvage logging around these four ponds would also reduce the recruitment of LWD and upland habitat suitability would be reduced. In this case, the temporal bounding for analyzing the cumulative effects of LWD recruitment would extend upwards of 150 years (or more) which is commensurate with the re-establishment of trees with a large diameter.

Minor behavioral changes caused by physical disturbance would be the primary effect to WPT at Grandfather Pond. The moderate level of cumulative action within the buffers at this site (35 percent) suggests a relatively short duration of activities for the 29 acres affected. There is a low potential for increased mortality or injury during late summer, as described above, as the pond size decreases. There would be a low to moderate reduction in habitat suitability in the treated area associated with the reduced LWD recruitment potential.

Hardhead

There should be very little cumulative effect on hardhead habitat in the North Fork Tuolumne, Clavey, and Tuolumne Rivers. 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. The Tuolumne River is unsuitable for breeding, but offers high suitability habitat for adults and sub-adults, especially in late summer.

Alternative 2 (No Action)

DIRECT AND INDIRECT EFFECTS

No direct effect would be expected under the No Action alternative. There would be no potential for mortality, injury, or physical disturbance of any of the three Forest Service Sensitive species created by salvage logging, abating the hazard of dead trees along forest roads, or restoring the road infrastructure.

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

The recruitment of large woody debris to the stream would occur at high rates over the next 10-20 years and then slowly taper off as the rot-resistant trees (incense cedar and Douglas fir) gradually fall. The LWD that lands on the floodplain and not in the channel would continue to be available for many decades. The LWD that falls into the streams should eventually benefit the stream by storing sediment generated by the fire and other events for long periods of time (greater than 20 years). Large debris dams store sediment and create pool habitats for many decades (Montgomery et al. 1996). The benefits of LWD will be most important in smaller streams (1st to 4rd order) and very important in lower gradient sections of streams (Ruediger and Ward 1996). Under this alternative, all sections of stream in the mixed conifer elevations have an unimpaired ability to receive large volumes of LWD. Large woody debris recruitment in lower elevation streams (less than 3,000 feet) will primarily recruit LWD from obligate riparian species and oak species.

One important consideration for Alternative 2 regarding the large volumes of LWD potentially recruited to stream channels, is that the LWD could mobilize during very high flows and threaten the road infrastructure. When LWD mobilizes down the channel and encounters a road crossing, the LWD can entrain (capture) other woody debris and sediment, creating a dam and preventing drainage of water and sediment through the culvert. Water could then: cross the road surface, be diverted by the road, or cause the crossing to fail. In all three instances, large volumes of road surface and fill could be

delivered to the stream channel, with the largest volumes of sediment coming from the failure of the crossing and erosion of the fill.

Stream shading would quickly 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.

Under Alternative 2, the road system would not receive any treatment to improve drivability and correct drainage problems. Roads can be a primary source of human-caused sediment in forested conditions because they modify drainage networks and accelerate erosional processes (Furniss et al. 1991). Past surveys of hydrologically connected road segments (HCS) on the forest have indicated considerable connectivity between road runoff and streams. In many cases, relatively uncomplicated techniques can be employed to reduce this road-stream connectivity and include: outsloping the road surface, creating water diversion structures (rolling dips), and placing rock on dirt road surfaces. Hydrologically connected road segments that deliver large volumes of sediment to streams appears to be relatively uncommon given the very large number of road miles on the forest, but the smaller scale HCS can cumulatively deliver large volumes of sediment. Regular road maintenance can be very effective at reducing sediment from this infrastructure. Alternative 2 would not generate revenue from merchantable timber to improve road function and many years could pass before those funds are made available to implement corrective actions. During this time, road conditions would gradually decline and increasing amounts of sediment could be delivered to streams in the project area.

Roadside hazard trees would be allowed to fall under this alternative limiting ready access to many parts of the fire. Forest Service personnel would not be as capable of conducting storm patrols of the fire area to detect road-related problems such as plugged culverts and gully erosion on the road surface. These potentially undetected problems could increase road crossing failures and extensive erosion of road surfaces, leading to excessive sediment delivery to many stream systems.

California red-legged frog

There would be no direct or indirect effects to the frog or its habitats arising from project activities if the no action alternative is selected. The main impact to California red-legged frog and its habitats under the no action alternative comes from the increased sedimentation and large woody debris recruitment predicted in the habitat areas resulting from post-fire runoff. Drew Creek would receive the largest amount of post-fire runoff because the upper watershed was extensively burned; however, the area immediately surrounding the suitable breeding habitat was not burned. Sediment would be delivered to the intermittent portion of the creek above Drew Meadow and much of the sediment would be gradually pushed through the meadow and into the breeding habitat. There would be a gradual movement of sediment over approximately five years because the low stream gradient in the meadow would retain the sediment for several years. Some sedimentation of pool habitat would occur in the next two or three years, but deep water habitats would be maintained from seasonal scouring as was observed following the 2005

Tuolumne Fire. Following that fire, relatively high levels of sediment affected pool volume and filled in the streambed in lower gradient sections (less than 4%) but was flushed from the system within three years. The upland habitat surrounding the breeding habitat would remain in its existing condition and LWD supply would not be diminished by project activities.

Relatively high levels of post-fire sedimentation would occur at the Harden Flat ponds because of the extent and severity of fire within their watersheds. Large woody debris would be available in very high levels primarily across the Middle Fork Tuolumne River and to the west of the ponds. Homestead Pond is expected to see minor increases in sedimentation, with Hunter Creek and Birch and Mud Lakes expecting low to moderate sedimentation depending on the watershed. In stream habitats, the sediment increases are expected to last one to two years before being washed downstream, although they could last as long as five years. Large woody debris is expected to increase from 1 to 5 years post fire as trees falls. This increase in large woody debris would provide upland refuge sites for red-legged frog. For the ponds, the fate of the sediment is more permanent and the volume of the pond could be slightly affected due to the sediment being retained in the pond.

Sierra Nevada yellow-legged frog

There would be no project related impacts to individuals or habitat associated with the absence of federally-implemented actions associated with this alternative. Reynolds Creek and the Kibbie Ridge ponds would see very little sedimentation due to the limited amount of fire within the watershed and low slope angle surrounding the ponds, respectively. Moderate increases in sediment delivery to channel would occur in Eleanor Creek and the Middle Fork Tuolumne River due to the extent and prevalence of high severity fire in the watersheds of these streams. At Eleanor Creek, the amount of sediment that would pass through the channel is limited because of Eleanor Dam. The sediment from upstream of the dam would be retained over a very long time period (>50 years). For the watershed area downstream of the dam, sedimentation would occur and affect the stream for up to three years, after which the seasonal snowmelt period would largely transport the sediment downstream and out of the suitable habitat area. Large volumes of sediment are expected to be delivered to the Middle Fork Tuolumne River and would impact slow water habitats in the river for two to three years until it is transported downstream and out of the suitable habitat area. For both the creek and river, the seasonal scour and presence of deep water habitats would ensure the availability of suitable habitat for post-metamorphic lifestages. Large woody debris supply would be unimpacted at all locations.

Foothill yellow-legged frog

The main impacts to FYLF habitat would come from increased sediment delivery to streams, increased streamflow, and reduced stream shading. For the streams shown in Table 8 categorized as “low watershed response”, very little change in habitat is expected, particularly at the location of breeding sites. Minor sedimentation will occur in the headwater tributaries affected by the fire, but that sediment will be dispersed downstream to the point where it will be undetectable at the breeding site. Some of the stream segments affected by fire provide suitable dispersal habitat for adult and sub-adult

FYLF, but the volume of deep water habitats should be adequately maintained, and the reduction in stream shade should have little effect on frog.

Streams categorized as "moderate watershed response" will see moderate to major adverse impact to the small order streams (1st-2nd order or headwaters) affected by fire. Deep water habitats may be extensively filled in dispersal habitats and there could be minor to moderate sedimentation in suitable breeding habitats. In some small tributaries affected by high severity fire, some deep water habitats may be unsuitable for individual frogs and they may have to move up- or downstream to suitable non-breeding aquatic habitat. The increase in sediment at breeding sites will likely have a minor impact to the suitability of the breeding habitat and reproduction should still occur. However, increased sediment in shallow water habitats used by tadpoles may see a reduction in suitability as the spaces between larger substrates are filled. The lack of hiding refuge may increase predation for the breeding season following the fire, but habitat suitability should be restored in the third or fourth breeding season post-fire. Stream shading was substantially reduced at a watershed scale (greater than 50 percent), though patches of shade remain. There could be slight increases in water temperatures, but these would be within the known tolerance range of the frog.

For streams and watersheds in the high watershed response category, major impacts to habitat have occurred or will occur this precipitation year. Excess sediment is likely to fill many of the deep water habitats to the point where they do not provide adequate refuge for frogs. This situation may not hold true for high gradient sections of stream where the water's energy has enough force to keep some deep pool habitat intact. There may be more individuals concentrated around the remaining pools, which would likely increase competition and territoriality between individuals. The increased interaction between individuals could increase stress levels and reduce physical well-being. In streams like Bull Meadow Creek, the sediment may be enough to inundate breeding habitat and preclude breeding in 2014. Streams in this category will also see extensive decreases in water depth in shallow water habitats, potentially enough to exclude extensive use of those habitats.

The environmental outcomes for this alternative range from major habitat alterations in very small streams to no discernible impact in the larger rivers. The biggest impacts to habitat would be expected to occur in the five Clavey River tributaries and Alder, Bear Springs, Bull Meadow, Corral, Drew, Granite, Indian, Indian Springs, Jawbone, and Quilty Creeks. Moderate localized to minor overall alterations in habitat would be expected to occur in Adams, Cherry, Grapevine, Hunter, Reed, and Russell Creeks, and the Middle and South Fork Tuolumne Rivers. Minimal impacts to habitat would be expected to occur in Basin, Bull, Cottonwood, Deer Lick, Eleanor, Hunter, Moore, and Scott Creeks, and the North Fork Tuolumne and Merced Rivers.

Western pond turtle

For the WPT, much of the discussion for the FYLF applies to the turtle for post-fire watershed response. There would be no risk of direct effect to individuals under this alternative. The post-fire erosion and sediment outcomes discussed for the FYLF apply to the WPT in that small streams with a high post-fire watershed response would see major impacts to the deep water habitats preferred by the turtle. In larger streams, the

period of annual peak streamflow would have sufficient energy to maintain high suitability deep water habitats created by scour.

The primary difference for the No Action alternative relates to recruitment rate of LWD into suitable aquatic habitats. Under Alternative 2, the recruitment rate would not be decreased due to salvage harvest and trees would be left to fall naturally. As noted previously, habitat suitability may be positively influenced by the increased abundance of basking sites (Jennings and Hayes 1994). More LWD would be recruited to all channels. The biggest increase in habitat suitability would likely occur in the larger streams and rivers like the Middle and South Fork Tuolumne Rivers.

The discussion of LWD recruitment also needs to include seasonal and perennial ponds and lakes at Abernathy Meadow, Big and Little Kibbie Ponds, Grandfather Pond, and Mud Lake. Under No Action, no trees would be harvested adjacent to lower quality roads or from salvage units surrounding these aquatic features leaving trees available for WPT use as they fall. As noted previously, the turtle will burrow under these objects in the upland to protect themselves from predators and weather elements. The unimpaired rate of recruitment of LWD would improve habitat suitability in the uplands surrounding the aquatic features.

The environmental outcomes under this alternative would follow natural post-fire processes and WPT populations would be maintained.

Hardhead

No direct or detectable indirect effect to hardhead individuals, populations, or habitat would result from No Action. At the scale of the lower Clavey, Tuolumne, and lower North Fork Tuolumne Rivers, the amount of post-fire sediment would not be enough to impair the suitability of the important habitat elements (deep pool, shallow edge water, and spawning habitats) in any of these locations.

CUMULATIVE EFFECTS

No direct effect on foothill yellow-legged frog, western pond turtle, or hardhead would result from the implementation of this alternative. The indirect effects described above focus on sedimentation of aquatic habitats and LWD recruitment but are not associated with any federal action. Therefore, this consideration of cumulative effects considers the effects of post-fire impacts combined with other actions carried out by federal or private entities. However, cumulative actions as described in the Federal Register (July 24, 2008; Volume 73, Number 143) only occur when the alternative proposals for agency action result in direct and indirect effects that then combine with other actions implemented or proposed by other governmental or private entities. Increased sediment would be expected from the road system if maintenance and restoration actions are not taken and LWD recruitment rates would remain very high in areas that sustained moderate and high vegetation severity fire conditions.

California red-legged frog

The cumulative stressors identified under Alternative 1 apply to this alternative, but the impacts identified in that section would not add cumulatively to the impacts of implementing this alternative because no federal action would occur. Table XX shows

the non-grazing actions proposed on federal or private lands that would affect the various CRLF habitats.

Sierra Nevada yellow-legged frog

If Alternative 2 is implemented, there would be no direct or indirect impacts to individuals or habitats at Reynolds Creek, Big and Little Kibbie Ponds, Eleanor Creek, or the Middle Fork Tuolumne River. As such, there would be no cumulative impacts when added to other actions potentially impacting the species at this location. As described in the cumulative effects section under Alternative 1, the Rim Hazard Tree EA would affect Reynolds Creek, but not the other three locations. Grazing would occur within the Reynolds Creek and Middle Fork Tuolumne River watersheds and would act as potential impact source at these locations.

Foothill yellow-legged frog

Using Table 14, the cumulative actions within each watershed can be derived for other actions on public and private lands. Very little or no cumulative effects would be expected in the following watersheds because there would be no other federal or private actions: Adams, Alder, Basin, Bull, Deer Lick, Eleanor, Indian Springs, Moore, and Russell Creeks, Clavey Tributaries 1, 2, 4, and 5, and the North Fork Merced River. Increased sedimentation from other salvage operations would not occur and LWD recruitment potential would coincide with the existing condition.

Minor to no discernible cumulative effect would be expected from the following watersheds because the other private or federal actions would only affect a very small percentage (less than 15 percent) of the FYLF buffer in the watershed or total watershed area: Bull Meadow, Cottonwood, Grapevine, Hunter, Indian, Indian Springs, and Reed Creeks, Clavey Tributary 3, and the Middle, North, and South Fork Tuolumne Rivers. In these streams, there would be localized increases in sedimentation, but the small cumulative percentage of FYLF buffer and watershed affected would not be sufficient to impair any biological function in the streams. FYLF habitat suitability would remain in the moderate suitability category until post-fire sediment is flushed from the systems (1-2 years) and relatively unimpaired habitat suitability would recover after 2 years.

Minor to moderate localized effect to aquatic habitats in the following locations: Bear Springs, Cherry, Corral, Drew, Jawbone, and Quilty Creeks. At these sites, the percentage of FYLF buffer affected ranges from 0 to 42 percent and the percentage of watershed area affected ranges from 14 to 60 percent. Relatively minor changes would be expected in Cherry and Drew Creeks, but the remaining streams could have moderate reductions in habitat suitability, compared to a pre-fire condition, in extensive areas of the watershed. The increases in sedimentation could affect breeding and rearing success in Jawbone and Corral Creeks for up to two years. Adult and sub-adult habitats should not be significantly compromised by sediment because high energy pools and sections of steep stream gradient should maintain good pool depth for refuge habitat. Bear Springs and Quilty Creeks likely serve as dispersal habitats for frogs breeding in the Clavey River. In these streams, slow water habitats, especially in low gradient headwater streams, could have low suitability for up to two years, but larger stream sections with higher gradient should maintain moderate to high suitability, deep water habitats.

Suitable habitats in the Clavey and Tuolumne River would not be measurably affected by cumulative impacts. These river systems are so large that the increases in sediment from all sources, including post-fire runoff, would not be sufficient to cause a reduction in suitability of habitat for any life stage or impair any biological function associated with the frog (example, algal growth (tadpole food) during the summer baseflow period).

Western pond turtle

The following locations would not have cumulative effects because there would be no risk of direct effect, a very low risk indirect effect (discountable effect on individuals and habitat), and no other federal or private action: Basin, Big Creek, Bull, Deer Lick, Eleanor, Moore, and the North Fork Merced and Tuolumne Rivers, Big Kibbie Pond, Little Kibbie Pond, and the three unnamed ponds near Yosemite Lakes Campground.

Very minor to no discernible effect to individuals would occur at the following locations: Cherry, Drew, and Hunter Creeks, and the Middle and South Fork Tuolumne Rivers. Other federal or private actions would affect up to 16 percent of the WPT buffer in these streams which would correlate to a low risk of direct impact, primarily physical disturbance. Localized areas of increased sedimentation would be apparent, but deep pool habitats would retain moderate to high suitability for the turtle. Shallow water habitats used by hatchlings should see minor reductions in suitability, but the habitat should meet the growth and development needs of the turtle.

Moderate levels of cumulative effect would be apparent at the following locations: Jawbone Creek, Grandfather and Homestead Ponds, Mud Lake, and Abernathy Meadow. For Jawbone Creek, the most apparent indirect impact would be increased sedimentation because approximately 50 percent of the watershed would be treated and 27 percent of the buffer would be treated. Deep water habitats would have minor to moderate reductions in volume, but the gradient and stream flow increases should maintain high quality pool habitat along most of the stream. The risk of direct effect is relatively low because the majority of the WPT buffer affected is in small tributary streams that provide low suitability habitat for the turtle. As for the ponds and meadow, between 20 and 55 percent of the buffer area would be treated by other private and federal actions. Mud Lake would be affected the most with over half of the buffer treated. At this location, the risk of physical disturbance is moderate and the risk of injury or mortality is relatively low. Operations would likely occur over a three to four week period and could occur when turtles are moving into the upland if the lake volume is reduced by 50 percent or more or if salvage activities occur into October when the turtles move into the upland. The potential recruitment of LWD would be reduced on the 63 acres treated, resulting in a habitat suitability reduction from just above moderate to just below moderate. For Homestead Pond, Grandfather Pond and Abernathy Meadow, more than 68 percent of the upland habitat would be unaffected by any action. There would be a low risk of physical disturbance because operations would only last a week or two at each location (16 - 42 treatment acres). Habitat suitability relative to LWD recruitment would be maintained in most of the upland area around each habitat.

Hardhead

There would be no cumulative effects to hardhead and habitat suitability would be maintained at high levels for all streams providing suitable habitat.

Alternative 3

DIRECT AND INDIRECT EFFECTS

California red-legged frog

The effects as described under alternative 1 are similar for all action alternatives. There are slight differences in acres treated and system, which is reflected in predicted erosion rates. This effects discussion follows the same outline as Alternative 1 for ease of comparison.

Birch and Mud Lakes

There are no activities proposed in the immediate vicinity (within 500 feet) of Birch or Mud Lake and all proposed activities occur downstream and/or downslope of the breeding habitat. 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 will remain low post-implementation.

There are 2.1 miles of non-breeding habitat within proposed salvage and fuels treatment units (Table 10) out of 7.4 miles in the habitat area (29 percent). Of this, 0.6 miles of the non-breeding habitat also falls within a proposed watershed sensitive area treatment. The non-breeding habitat in the Tuolumne River – Poopenaut Valley watershed (north half of habitat area) only has proposed treatment at the headwaters of the stream. Proposed treatments immediately adjacent to the non-breeding habitat include drop and lop treatment in a watershed sensitive area (WSA) to increase ground cover and reduce erosion. Most of the non-breeding aquatic habitat in the Lower Middle Fork Tuolumne River and Upper Middle Fork Tuolumne River watershed is within proposed salvage harvest. There is a 72 acre drop and lop WSA treatment in the Lower Middle Fork Tuolumne River along the intermittent outlet stream from Birch Lake specifically delineated to increase coarse cover for California red-legged frog and reduce erosion. WEPP modeling does not show a change in post-implementation erosion in the Tuolumne River – Poopenaut Valley or Upper Middle Fork Tuolumne River watersheds. Although no change is shown it is likely that implementation activities will result in some erosion and there will be some sediment delivery to the stream. The amount is not detectable above the background of the predicted fire erosion. The Lower Middle Fork Tuolumne watershed modelling indicates erosion will be reduced from 2.8 tons per acre post fire to 2.4 tons per acre post-implementation. This is in large part due to the proposed WSA treatments within the greater watershed area. Despite the predicted decrease in erosion, some sediment is still likely to enter the non-breeding aquatic habitat due to salvage, hazard tree and fuel reduction treatments.

Removal of salvage will not affect stream shading in this area as dead trees provide little shade. LWD recruitment will be reduced along the non-breeding habitat in the Lower Middle Fork Tuolumne River and Upper Middle Fork Tuolumne River. The MRs would maintain 5 standing trees per acre within the Riparian Conservation Areas (RCAs) of perennial streams as recruitment for downed wood. Existing downed wood crossing or within 30 feet of a stream will be retained. There are no planned water sources within this habitat area. Roadside Hazard Tree Removal and road treatments in this area do not occur near aquatic habitat.

Twenty-seven percent of the upland habitat is proposed for harvest and roadside salvage treatment, and 24 percent of the upland habitat with salvage treatment will also have fuels treatment. These activities can further decrease cover from the effects of the fire, and can set back vegetative regrowth by one to two years. 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. 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 salvage units, or within hazard tree removal areas. There is no risk of disturbance or injury at the breeding habitat. Adjacent to the breeding habitat there is planned roadside hazard tree removal that comes close to the breeding habitat in two locations. Reduction in stream shading below that caused by the fire is not anticipated, and therefore no increase in temperature is expected.

A total of 10.3 miles of non-breeding stream habitat is within the Drew Creek habitat area. There are 0.16 miles of non-breeding habitat in the Lower Middle Fork Tuolumne River watershed within proposed salvage units and 0.05 miles within roadside hazard tree removal units (total of 2 percent) (Table 10) in the Tuolumne River – Jawbone Creek watershed. WEPP modeling indicates erosion will be reduced from 2.8 tons per acre post fire to 2.4 tons per acre post-implementation in Lower Middle Fork Tuolumne River watershed and from 3.6 to 3.3 tons per acre in the Tuolumne River – Jawbone Creek watershed. This is a decrease in sediment delivery from Alternative 1 and the no action alternative. Even with the predicted decreased due to project implementation it is likely that implementation activities will result in some erosion and there will be some sediment delivery to the streams. The amount is not detectable above the background of the predicted fire erosion.

The proposed activities will not alter stream shading. There is very little activity proposed in this habitat area adjacent to streams and in many areas LWD will not be altered. The area along Lumsden Road where roadside hazard trees will be removed will have LWD maintained as described above. There is one proposed water source in the Drew Creek habitat area. It is a water trough/tank located in Section 21 south of Drew Creek and south of the proposed roadside hazard tree removal. This trough does not currently have any red-legged frog populations in it. Lumsden Road crosses the Tuolumne River within this habitat area at Lumsden Bridge. Road treatments are planned across this non-breeding habitat. Some sediment may enter the stream from the road treatments and may continue for one to two years. However, road treatments are designed to reduce hydrologically connected roads segments and any increased sediment will decrease after two years.

Seven percent of the upland habitat is proposed for harvest and roadside salvage treatment, with 1 percent of the upland habitat also receiving fuels treatments (Table 9). These activities can further decrease cover from the effects of the fire, and can set back

vegetative regrowth by one to two years. 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 will have no effect on the existing habitat.

Harden Flat Ponds

The breeding habitat within this habitat area is on private property and is not included within any proposed salvage units, or within hazard tree removal areas. There is no risk of disturbance or injury at the breeding habitat. Breeding habitat will maintain low suitability for red-legged frogs in this area.

There are 0.36 miles of non-breeding habitat in the Lower South Fork Tuolumne River watershed and in the Lower Middle Fork Tuolumne River watershed (Table 10) within salvage and roadside hazard tree treatment units. WEPP modeling indicates erosion will be reduced from 2.8 to 2.4 tons per acre in the Lower Middle Fork Tuolumne River watershed post-implementation, and from 3.1 to 2.8 tons per acre in the Lower South Fork Tuolumne River watershed. Even with the predicted decrease post implementation it is likely that implementation activities will result in some erosion and there will be some sediment delivery to the streams. The amount is not detectable above the background of the predicted fire erosion.

The proposed activities will not alter stream shading. There is very little activity proposed in this habitat area adjacent to streams. Of the 6.4 miles of non-breeding habitat, only 0.36 miles (6 percent) will have trees removed. MRs will maintain some standing trees to provide for LWD recruitment. There are no proposed water sources in this area. None of the proposed road treatments cross stream habitat (they are not hydrologically connected) and it is unlikely sediment from road treatments will reach the streams.

Thirteen percent of the upland habitat is proposed for harvest and roadside salvage treatment (Table 9), with 10 percent also proposed for fuel treatment. These activities can further decrease cover from the effects of the fire, and can set back vegetative regrowth by one to two years. 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 habitat is on the private property and will not be impacted by this action.

Homestead Pond

Homestead Pond is within a proposed salvage harvest. The harvest unit is limited to the north and east sides of the pond and is reduced in size to 15.1 acres from Alternative 1. There would be a high risk of injury or mortality to breeding red-legged frogs in this pond during project activities. However, the pond does not currently support red-legged frogs. Reduction in stream shading below that caused by the fire is not anticipated, and therefore no increase in temperature is expected. The pond and salvage unit are on flat ground, therefore sediment is not expected to move into the pond in great quantities. However, some sedimentation is anticipated.

There are 4.8 miles of non-breeding stream habitat within the Homestead Pond habitat area. There is no proposed roadside hazard tree removal (Table 10) in this habitat area under Alternative 3. Only the north half of the habitat area is within the Rim Fire, in the Grapevine Creek-Tuolumne River watershed. WEPP modeling indicates erosion will be reduced from 2.0 tons per acre post fire to 1.9 tons per acre post-implementation. Even with the predicted decreased due to project implementation it is likely that implementation activities will result in some erosion and there will be some sediment delivery to the non-breeding habitat. The amount is not detectable above the background of the predicted fire erosion.

The proposed activities will not alter stream shading. There is very little activity proposed in this habitat area adjacent to streams and in most of the area LWD will not be altered. There are no proposed water sources in the Homestead Pond habitat area. One road in the project area crosses the non-breeding habitat provided by the Hetch Hetchy ditch feature. Because the road may be hydrologically connected to the non-breeding habitat, some sediment may enter the stream from the road treatments and may continue for one to two years. These road treatments are designed to reduce hydrologically connected roads segments and any increased sediment will decrease after two years.

Three percent of the upland habitat is proposed for harvest and roadside salvage treatment (Table 9), with one percent of the habitat proposed for fuels treatment in the harvested units. These activities can further decrease cover from the effects of the fire, and can set back vegetative regrowth by one to two years. 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. There is no dispersal habitat in this habitat area.

Hunter Creek and Ponds

There are no salvage activities proposed within the Hunter Creek and Ponds habitat area. Hazard Tree Removal is proposed near the Hunter Creek breeding habitat in Section 17 (near Skidmore Pit). There is a slight risk of injury or mortality at this location; however this is mitigated by the management requirement to fell trees away from the stream. There will be no reduction in shading at breeding habitats (stream or pond) below that caused by the fire; therefore temperature will not be altered by this project. The proposed hazard tree removal and road treatments in Section 17 may result in a minor amount of additional sediment input into Hunter Creek due to the proximity to the creek. This additional input may last one to two years, and then will be reduced.

There are 26.8 miles of non-breeding stream habitat within this habitat area. There are 3.1 miles (12 percent) of non-breeding habitat within proposed roadside hazard tree removal units (Table 10). The majority of non-breeding habitat consists of tributaries to Hunter Creek in the Lower North Fork Tuolumne River watershed and most was not burned in the Rim Fire. The non-breeding habitat within the Tuolumne River – Grapevine Creek watershed was burned. WEPP modeling indicates erosion will be slightly reduced from 2.0 tons per acre post fire to 1.9 tons per acres post-implementation in this watershed. Even with the predicted decreased due to project implementation it is likely that implementation activities will result in some erosion and there will be some

sediment delivery to the streams. The amount is not detectable above the background of the predicted fire erosion.

The proposed activities will not alter stream shading. There is very little activity proposed in this habitat area adjacent to streams and in most of the area LWD will not be altered. There are five proposed water sources in the Hunter Creek and Ponds habitat area; one water trough/tank that is not known to contain red-legged frogs, one site at the junction of Hunter Creek and Buchanan Road in breeding habitat, and three sites in non-breeding habitat along Forest Service roads 1N01, 1N27 and 1N35. Drafting in the latter four locations has the potential to entrain tadpole or smaller California red-legged frogs of they are present during activities, and can also result in disturbance in the area. There are several roads in the area that cross non-breeding habitat that provide some hydrologic connectivity. Some sediment may enter the streams from the road treatments and may continue for one to two years. These road treatments are designed to reduce hydrologically connected roads segments and any increased sediment will decrease after two years.

Ten percent of the upland habitat is proposed for roadside salvage and fuel treatment (Table 9). These activities can further decrease cover from the effects of the fire, and can set back vegetative regrowth by one to two years. However, only a little more than half of the upland habitat was within the fire and experienced changes. 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. The dispersal habitat along Hunter Creek would not be altered by the proposed activities.

Sierra Nevada yellow-legged frog

Effects to Individuals

The actions proposed for Alternative 1 are the same under Alternative 3 and the analysis provided for Alternative 1 applies to this alternative.

Effects to Habitats

The actions proposed for Alternative 1 are the same under Alternative 3 and the analysis provided for Alternative 1 applies to this alternative.

Foothill yellow-legged frog

The potential for direct and indirect effects for Alternative 3 are largely the same as those in Alternative 1. Table 15 indicates the extent to which salvage and roadside hazard abatement would affect the amount of buffer and overall area of each watershed. Table 15 also shows the number of miles of road treatment by activity type for Alternative 3. Comparing Table 15 to Table 11, there are no differences between salvage treatments (hazard tree and salvage units) between Alternatives 1 and 3. These watersheds include North Fork Merced and Tuolumne Rivers and Basin, Clavey Tributaries 1-3 and 5, Deer Lick, Grapevine, Hunter, Indian, Indian Springs, Quilty, Moore, Russell, and Scott Creeks. Direct and indirect effects described in Alternative 1 directly apply to these watersheds for Alternative 3.

There are very minor differences (less than 10 percent and mainly decreases) in either amount of salvage treatment in buffer areas or percentage of watershed area in the

following watersheds: Adams, Bear Springs, Bull, Cherry, Clavey River Tributary 4, Cottonwood, Drew, Eleanor, Granite, and Reed Creeks, and the Middle and South Fork Tuolumne Rivers. The small differences between the amounts of area treated by salvage activities would not be discernible between Alternatives 1 and 3. The sediment modeling reflects little or no change in sediment delivery for these watersheds.

Table 15. Amount of buffer, percentage of watershed area affected, and miles of road treatments in foothill yellow-legged frog suitable habitat for Alternative 3.

Watershed (5th level Hydrologic Unit Code)	Stream name	Percent of FYLF watershed area treated, hazard tree and salvage units combined	Acres of FYLF buffer affected			Road Treatments (miles by treatment type)			
			Hazard tree	Salvage	Percent of total	Recon-struct	Maintain	New	Temporary
Tuolumne River	Tuolumne River								
	Alder Cr.	45	0	34	30	3.2	0.2	0	0
	Corral Cr.	78	0	106	46	18.9	0	0	2.5
	Drew Cr.	12	12	0.4	11	1.9	3.6	0	0.6
	Grapevine Cr.	18	29	0	11	0.7	17.4	0	0
	Indian Cr.	2	1	0	less than 1	0	2.2	0	0
	Jawbone Cr.	27	5	81	25	18.6	7.3	0	5.3
Middle Fork Tuolumne River	Middle Fork Tuolumne River	17	22	255	46	57.2	12.5	0	11.9
North Fork Tuolumne River	North Fork Tuolumne River	2	0	0	0	0.4	22.7	0	0
	Basin Cr.	1	0	0	0	0.4	2.1	0	0
	Hunter Cr.	9	0	0	0	0	19.9	0	0
South Fork Tuolumne River	South Fork Tuolumne River	38	29	144	24	75.5	27.3	0	4
Cherry Creek	Cherry Cr.	13	6	36	9	29.3	9.9	0	1.6
	Eleanor Cr.	1	0	12	22	2.5	0	0	0.5
	Granite Cr.	21	0.2	36	25	12.4	1.1	0	0.1
Clavey River	Clavey River								
	Reed Cr.	20	1	49	49	18.2	24.7	0	2.1
	Adams Gulch	15	0	0	0	1.2	1.8	0	0
	Bear Springs Cr.	18	9	0.1	20	10	0.7	0	0
	Bull Meadow Cr.	36	0	36	50	4.0	0.4	0	0.8
	Indian Springs Cr.	19	3	2	25	1.4	0.1	0	0
	Quilty Cr.	5	0	0	0	0.1	1.1	0	0

Watershed (5th level Hydrologic Unit Code)	Stream name	Percent of FYLF watershed area treated, hazard tree and salvage units combined	Acres of FYLF buffer affected			Road Treatments (miles by treatment type)			
			Hazard tree	Salvage	Percent of total	Recon-struct	Maintain	New	Temporary
	Unnamed Tributary 1	16	3	0	8	0	2.9	0	0
	Unnamed Tributary 2	24	0	0	0	0	2.5	0	0
	Unnamed Tributary 3	69	0	26	46	0.8	10.3	0	0
	Unnamed Tributary 4	48	2	1	13	3	0.7	0	0
	Unnamed Tributary 5	43	7	8	37	2.2	2.7	0	0
	Cottonwood Cr.	31	0	3	5	19.1	8.8	0	0.1
	Russell Cr.	30	0	0	0	0.9	2.3	0	0
North Fork Merced River	North Fork Merced River	2	22	18	less than 0.1	12.3	11.2	0	0.2
	Bull Cr.	2	5	0	less than 0.1	3.95	2	0	0.5
	Deer Lick Cr.	8	4	13	7	3.4	2.3	0	0.2
	Moore Cr.	4	5	5	3	2	3.8	0	1
	Scott Cr.	22	2	0	8	3.6	3.4	0	0

The following watersheds would see increases in activity from Alternative 1 to Alternative 3: Alder, Corral, and Jawbone Creeks. In Alder Creek, the amount of treatment in FYLF buffer areas increases from 0 (Alternative 1) to 34 acres and the percentage of watershed treated increases from 10 (Alternative 1) to 45 percent. This alternative includes unit L204, a forage unit in critical winter deer range, where dead trees would be removed as biomass. A review of the aerial imagery indicates widely scattered small, dead pines. The amount of disturbance created by equipment in this unit would be limited greatly (spatially) and there should be no discernible changes in sediment delivery to suitable habitat located downstream of the treatment unit.

A similar situation exists in Corral Creek where the amount of treatment in FYLF buffers increases from 81 (Alternative 1) to 106 acres (Alternative 3) and the percentage of watershed treated increases from 58 percent to 78 percent, between Alternatives 1 and 3, respectively, in critical winter deer range. The increased amount of disturbance created by additional equipment operation would increase the amount of sediment delivered to Corral Creek, especially in the lower third of the watershed. The additional sediment would slightly diminish suitability of FYLF aquatic habitat in the first year following treatment, but the steep gradient would likely transport the sediment out and to the Tuolumne River in the subsequent year.

The percentage of FYLF buffer affected by salvage logging in Jawbone Creek would increase from 13 percent in Alternative 1 to 24 percent in Alternative 3, but the total

watershed area treated would decrease from 25 percent (Alternative 1) to 15 percent under Alternative 3. The increased activity in FYLF buffers would occur in the lower fourth of the watershed, and there would be a slight increase in sediment delivered to Jawbone Creek from the additional treatment units. This increase would slightly decrease aquatic habitat suitability for the FYLF because deep water refuge habitats would be reduced. The duration of effect would remain the same between alternatives because the steep gradient of the creek in this part of the watershed would effectively transport out the sediment.

For the Tuolumne and Clavey Rivers, there would be no discernible difference in impact to aquatic and riparian habitats between Alternatives 1 and 3 because the amount of sediment predicted for both alternatives is very similar (at this large watershed scale) and there would be very little or no activity in close proximity to the rivers. High suitability habitat would be maintained in these rivers and no biological impairment would occur.

Western pond turtle

For 20 of the 22 aquatic features identified in Table 16, there is either no difference or very small differences (less than 2 percent) in the amount and type of treatment within WPT buffers. As such, the descriptions of environmental consequences provided for the WPT under Alternative 1 apply to Alternative 3. The two aquatic features where treatment amounts within the buffer are different are Abernathy Meadow and Mud Lake. At Abernathy Meadow, the percentage of buffer surrounding the meadow affected by salvage operations decreased from 66 acres (50 percent of total buffer area) to 26 acres (20 percent of total buffer area). The decrease in logging activity in the buffer would result in a lower potential for direct impacts to individuals, especially when the seasonal pond is losing volume and the turtles move into the upland for the summer to aestivate. The decreased logging around the meadow under this alternative would mean more trees would be available to fall and provide cover for turtles in 40 additional acres (when compared to Alternative 1). The additional amount of LWD would improve the overall upland habitat suitability, from moderate to high, in Alternative 3 compared to Alternative 1.

At Mud Lake, a similar situation would occur because the amount of buffer area treated would decrease by 9 acres (21 to 12). This means only 10 percent of the buffer area would be treated. The direct and indirect effects discussed for Abernathy Meadow apply to Mud Lake.

Table 16. Amount and percentage of western pond turtle buffer affected in salvage and roadside hazard tree units for Alternative 3.

Watershed (5th level Hydrologic Unit Code)	Stream name	Amount of WPT buffer in salvage units (percent of total buffer area treated)	Amount of WPT buffer in hazard tree units (percent of total buffer area treated)
Tuolumne River	Drew Cr.	27 (3 percent)	89 (9 percent)
	Jawbone Cr.	701 (22 percent)	102 (3 percent)
	Homestead Pond	15 (16 percent)	0 (0 percent)
	Three unnamed ponds	27 (10 percent)	4 (1 percent)
Middle Fork Tuolumne River	Middle Fork Tuolumne River	2113 (39 percent)	307 (6 percent)
	Abernathy Meadow	26 (20 percent)	6 (5 percent)

Watershed (5th level Hydrologic Unit Code)	Stream name	Amount of WPT buffer in salvage units (percent of total buffer area treated)	Amount of WPT buffer in hazard tree units (percent of total buffer area treated)
	Grandfather Pond	7 (9 percent)	2 (2 percent)
	Mud Lake	12 (10 percent)	0 (0 percent)
North Fork Tuolumne River	North Fork Tuolumne River	0 (0 percent)	411 (2 percent)
	Basin Cr.	0 (0 percent)	0 (0 percent)
	Hunter Cr.	0 (0 percent)	407 (2 percent)
South Fork Tuolumne River	South Fork Tuolumne River	1441 (22 percent)	537 (8 percent)
Cherry Creek	Cherry Cr.	365 (10 percent)	59 (2 percent)
	Eleanor Cr.	97 (16 percent)	0.1 (less than 1 percent)
	Big Kibbie Pond	86 (88 percent)	0 (0 percent)
	Little Kibbie Pond	52 (60 percent)	2 (2 percent)
Clavey River	Reed Cr.	438 (48 percent)	12 (1 percent)
	Cottonwood Cr.	29 (5 percent)	24 (5 percent)
North Fork Merced River	North Fork Merced River	176 (1 percent)	491 (3 percent)
	Bull Cr.	25 (less than 1 percent)	109 (1 percent)
	Deer Lick Cr.	42 (2 percent)	109 (5 percent)
	Moore Cr.	56 (2 percent)	60 (2 percent)

Hardhead

There would be no discernible differences between Alternatives 1 and 3 for the hardhead. The direct and indirect effects discussion for Alternative 1 applies for to this alternative.

CUMULATIVE EFFECTS

California red-legged frog

For most of the analyzed sites, there are very small differences in the actions proposed in Alternatives 1 and 3 and probably not detectable at the habitat area or watershed scale. Because the differences between implementing either alternative would be indistinguishable, the cumulative effects for Alternative 3 are as discussed under Alternative 1.

Sierra Nevada yellow-legged frog

Same as Alternative 1 because the proposed action within the SNYLF analysis areas would be the same under Alternatives 1 and 3.

Foothill yellow-legged frog

Comparing Tables 14 (cumulative effects for Alternative 1) and 17 (cumulative effects for Alternative 3), only four watersheds (Alder, Bull Meadow, Corral, and Jawbone Creeks) would have an increase in activities. The remaining watersheds would have no change or very little decrease in the amount of buffer or watershed area treated and the cumulative effects discussions under Alternative 1 are the same or very similar for this alternative.

Table 17. Percentage of watershed area and foothill yellow-legged frog and western pond turtle buffers affected by salvage activities in Alternative 3 and cumulative sources (public and private).

Watershed (5th level	Percent of FYLF buffer affected	Percent of watershed area treated	Percent of WPT buffer affected

Hydrologic Unit Code) and Stream name	Alternative 3	Alternative 3 + Cumulative	Alternative 3	Alternative 3 + Cumulative	Alternative 3	Alternative 3 + Cumulative
Tuolumne River						
Alder Cr.	30	30	45	45	--	--
Corral Cr.	46	88	78	93	--	--
Drew Cr.	17	28	12	29	11	27
Grapevine Cr.	11	18	18	23	--	--
Indian Cr.	1	6	2	4	--	--
Jawbone Cr.	25	54	15	68	25	53
Homestead Pond	--	--	--	--	16	46
Middle Fork Tuolumne River						
Middle Fork Tuolumne River[1]	45	57	48	61	45	57
Abernathy Meadow	--	--	--	--	24	56
Grandfather Pond	--	--	--	--	11	30
Mud Lake	--	--	--	--	10	65
North Fork Tuolumne River						
North Fork Tuolumne River	0	2	1	6	2	6
Basin Cr.	0	0	1	5	0	less than 0.1
Hunter Cr.	6	14	9	23	8	19
South Fork Tuolumne River						
South Fork Tuolumne River[2]	10	34	36	46	31	40
Unnamed ponds near Yosemite Lakes	--	--	--	--	5	8
Cherry Creek						
Cherry Cr.	10	26	13	34	29	45
Eleanor Cr.	22	22	1	1	16	16
Big Kibbie Pond	--	--	--	--	88	88
Little Kibbie Pond	--	--	--	--	63	63
Granite Cr.	25	67	21	78	--	--
Clavey River						
Reed Cr.	50	54	20	34	50	61
Adams Gulch	0	0	15	32	--	--
Bear Springs Cr.	20	31	18	78	--	--
Bull Meadow Cr.	50	59	65	77	--	--
Indian Springs Cr.	25	25	19	29	--	--
Quilty Cr.	0	0	5	73	--	--
Unnamed Tributary 1	8	8	16	16	--	--
Unnamed Tributary 2	0	0	24	24	--	--

Watershed (5th level Hydrologic Unit Code) and Stream name	Percent of FYLF buffer affected		Percent of watershed area treated		Percent of WPT buffer affected	
	Alternative 3	Alternative 3 + Cumulative	Alternative 3	Alternative 3 + Cumulative	Alternative 3	Alternative 3 + Cumulative
Unnamed Tributary 3	46	50	69	78	--	--
Unnamed Tributary 4	13	13	43	48	--	--
Unnamed Tributary 5	37	37	43	45	--	--
Cottonwood Cr.	5	18	31	43	--	--
Russell Cr.	0	0	30	30	--	--
North Fork Merced River						
North Fork Merced River	2	2	3	4	4	4
Bull Cr.	less than 0.1	less than 0.1	2	2	1	1
Deer Lick Cr.	7	7	8	8	7	7
Moore Cr.	3	3	4	6	6	7
Scott Cr.	4	4	22	22	--	--

[1]Percentages calculated for the 6th level HUC Lower Middle Fork Tuolumne and not for the 5th level HUC
[2]Percentages calculated for the 6th level Lower South Fork Tuolumne River HUC

The four streams with increases in buffer and watershed area treated have cumulative total increases directly related to the amount of increased activity proposed under Alternative 3 and not from additional sources. That is, no cumulative effects increase is associated with private or other public activities. The environmental outcome discussed for Alder Creek would be the same for cumulative impacts in terms of risk to individuals and habitats. Jawbone and Bull Meadow Creeks would likely see high cumulative levels of physical disturbance to individuals because extensive areas of the buffer would be treated by salvage activities. The total amount of watershed area affected would also lead to extensive modification of aquatic habitats (channel filling from sedimentation) in the first two or three years following treatment. This extent of aquatic habitat modification would potentially impact breeding and tadpole development for the first two years following treatments. As a result, lower population numbers would be expected for five to seven years. Reproduction and recruitment rate in these streams would return to "normal" levels within four years of treatment and high habitat suitability would return.

Essentially all of the buffer and watershed area of Corral Creek would be impacted by some type of salvage logging. The watershed response would be uncertain and it is possible that aquatic habitat in most of Corral Creek would be unsuitable for the FYLF due to excessive sedimentation. Based on field experience during physical habitat surveys prior to the Rim Fire, there are some high gradient sections that, when combined with the anticipated increase in stream flow, should maintain small patches of moderate suitability deep water habitat. This may provide enough of a refuge for the frog to persist until additional habitat becomes available in the next two or three years. Breeding would likely not occur under these conditions for up to two years, resulting in decreased recruitment and population size for over ten years. From two to four years from present, preferred tadpole habitat could be considerably compromised because the anticipated amount of sediment would likely fill the spaces between the larger streambed substrates and reduce foraging and escape habitats. Low suitability foraging and escape habitats

could lead to poor rates of survivorship and increased predation. The cumulative effects modeling for this watershed and alternative indicate the threshold of concern would be exceeded for the next six years suggesting the channel and streambanks could be highly unstable for up to a decade. It should be noted that the erosion and sediment modeling completed for the project indicated a reduction in sediment delivery compared to the post-fire (no action) conditions and those expected from implementing Alternative 1.

Western pond turtle

Comparing Table 14 (cumulative effects for Alternative 1) and Table 17 (cumulative effects for Alternative 3) indicates most values in Alternative 3 for percentage of buffer affected were the same or slightly (less than 5 percent) increased or decreased from those in Alternative 1. Given the limited amount of change (or lack of change) between the values, the extent of impact and risk to individuals is very similar between alternatives and the cumulative effects discussion for Alternative 1 applies to this alternative.

Hardhead

The discussion of cumulative effects given under Alternative 1 applies to this alternative.

Alternative 4

DIRECT AND INDIRECT EFFECTS

As with Alternative 3, there would be very little difference implementing Alternative 4 when compared to Alternative 1 for all three sensitive aquatic species. Further, for the watersheds that differed between Alternatives 1 and 3, there are no substantial differences in amount of watershed treated between Alternatives 3 and 4. That is, the salvage and road treatments are very similar in Alternatives 3 and 4. For 30 of the 34 watersheds listed in Table 13, there are no differences in actions proposed under Alternative 3 and 4. The following watersheds have differences between Alternative 3 and 4: Cherry and Eleanor Creeks and the South Fork Tuolumne River.

California red-legged frog

The only differences between Alternative 3 and Alternative 4 in proposed treatments is an additional 0.3 acres salvage treatment in Birch and Mud Lakes habitat area, an additional 0.1 acre of salvage treatment in the Homestead Pond habitat area, and 0.4 acres less roadside Hazard treatment in Hunter Creek and Ponds habitat area. The difference in the amount of activity would not be detectable at the habitat area or at a watershed scale. Therefore, the analysis of direct, indirect and cumulative effects for Alternative 4 is the same as for Alternative 3.

Sierra Nevada yellow-legged frog

Effects to Individuals

Tree Felling and Removal

For Reynolds Creek, Eleanor Creek, and the Middle Fork Tuolumne River, there would be no difference in implementing Alternative 4 from Alternatives 1 and 3 because the proposed actions within these analysis areas would be the same. At Big and Little Kibbie Ponds, unit O02 would be dropped from treatment but roadside salvage would occur along 1N40Y in places where the salvage unit was proposed. Overall, there would be a decrease in the amount of upland habitat around the ponds impacted by this alternative.

This alternative would affect approximately one acre of upland habitat less than Alternative 1 around Little Kibbie Pond and 0.6 acre of upland habitat less than Alternative 1 around Big Kibbie Pond. The effects and consequences of this difference are essentially the same as those described in Alternative 1, but this alternative would result in a slightly reduced risk of direct impact (injury, mortality, and physical disturbance) to individuals during tree felling and removal. At Eleanor Creek, unit O201B would be dropped and project activities would not occur along 0.15 mile of the creek. This unit was approximately 100 feet away from the creek under Alternative 1, which is a big enough operational buffer to minimize the potential for impacts to individuals. Dropping unit O201B would not result in a substantial decrease in risk to individuals when compared to the activities in Alternative 1.

Burn Piles

For Reynolds Creek, Eleanor Creek, and the Middle Fork Tuolumne River, there would be no difference in implementing Alternative 4 from Alternatives 1 and 3 because the proposed actions within these analysis areas would be the same. For Big and Little Kibbie Ponds, burn piles would not occur in 1.6 acres of upland habitat when compared to Alternative 1. The same minimization measure of locating burn piles more than 50 feet from aquatic habitats would occur in this alternative. For the 1.6 acres of upland habitat that would be untreated, the risk of an individual being impacted during pile burning would be reduced because of the lack of activity in the unaffected upland habitat.

Road Treatments

For Reynolds Creek, Big and Little Kibbie Ponds, Eleanor Creek, and the Middle Fork Tuolumne River analysis areas, there would be no difference in implementing Alternative 4 from Alternatives 1 and 3 because the proposed actions within these analysis areas would be the same.

Water Drafting

For all sites, there would be no difference in implementing Alternative 4 from Alternatives 1 and 3 because the proposed actions within these analysis areas would be the same.

Application of Registered Borate Compound

For all sites, there would be no difference in implementing Alternative 4 from Alternatives 1 and 3 because the proposed actions within these analysis areas would be the same.

Effects to Habitats

In general the risk of actions proposed in Alternative 4 would be lower than those proposed in either Alternative 1 or Alternative 3 because there would be slightly less activity in SNYLF upland habitat specifically around Big and Little Kibbie Ponds and adjacent to Eleanor Creek.

Increases in Sediment

Breeding and Non-breeding Aquatic Habitat: For Reynolds Creek, Big and Little Kibbie Ponds, and the Middle Fork Tuolumne River, there would be no difference in the amount

of sediment is essentially the same for Alternative 4 as it is in Alternative 1. Because unit O02B would be dropped from the Eleanor Creek watershed, there would be slightly less sediment produced from the eastern hillslope than in Alternative 1. The amount of difference would be so small that the observable impacts to habitat in the creek would not be distinguishable from the sediment expectations in Alternative 1. As with Alternative 1, the duration of sediment in all habitats would be relatively short (up to two years) and there would be no impairment of habitat by the sediment.

Large Woody Debris

Upland Habitat: There would be no difference between Alternatives 1, 3, and 4 in LWD supply at Reynolds Creek and the Middle Fork Tuolumne River because the amount and type of activity would be the same. At Big and Little Kibbie Ponds, there would be 1.6 acres more of upland habitat that would be unimpacted by project activities and reductions in LWD would not occur in these 1.6 acres. At Eleanor Creek, there would be very little difference between Alternatives 1 and 4 because unit O02 would be dropped, but this unit was more than 100 feet away from the stream and the upland buffer is approximately 82 feet (25 meters).

Foothill yellow-legged frog

Similar to Alternative 1 acreage, salvage activities would treat 54 acres of buffer in Cherry Creek. The environmental outcome based on this amount of buffer treated would be very similar to the outcome stated for Alternative 1; however, the total amount of watershed area treated in this alternative would be 594 acres less than what would be treated in Alternative 1 (3,302 acres in Alternative 1 versus 2,708 acres in Alternative 4). There may be a tradeoff in terms of sediment delivery to Cherry Creek between more acres treated in the FYLF buffer and fewer acres treated in total for the watershed, meaning slightly more sediment may come from the additional buffer areas and less from the non-buffer watershed acres. The sediment modeling indicated a 4 percent overall decrease in sediment delivery to the creek between Alternative 4 and Alternative 1. A change this small means there may be no detectable difference between the two alternatives and the categorization of Cherry Creek under Alternative 1 applies to this alternative.

Eleanor Creek would have no change to the amount of FYLF buffer affected by salvage operations, but there would be an 83 acre decrease in total watershed area affected by salvaging. This is a 15 percent reduction in acres treated compared to Alternative 1. The reduced amount of salvage activity would mean a slight reduction in sediment delivery to Eleanor Creek, but the magnitude of effect would be very small and may not be discernible from Alternative 1. The sediment modeling indicated a slight decrease in sediment delivery for this watershed between this alternative and Alternative 1, a difference of 482 tons (13,982 tons in Alternative 1 versus 13,496 tons in Alternative 4) or 3 percent.

For the South Fork Tuolumne River, the percentage of buffer treated in all action alternatives is the same, but the amount of watershed area treated decreases by 132 acres between Alternative 1 and Alternative 4. This difference in area treated would not have a detectable difference than that of Alternative 1. The discussion for Alternative 1, therefore, applies to this alternative.

Table 18. Amount of buffer, percentage of watershed area affected, and miles of road treatments in foothill yellow-legged frog suitable habitat for Alternative 4.

Watershed (5th level Hydrologic Unit Code)	Stream name	Percent of FYLF watershed area treated, hazard tree and salvage units combined	Acres of FYLF buffer affected			Road Treatments (miles by treatment type)			
			Hazard tree	Salvage	Percent of total	Recon-struct	Maintain	New	Temporary
Tuolumne River	Tuolumne River								
	Alder Cr.	45	0	34	30	3.2	0.2	0	0
	Corral Cr.	78	0	106	46	19.6	0.2	0	1.7
	Drew Cr.	12	12	0.4	11	1.9	3.6	0	0.6
	Grapevine Cr.	18	29	0	11	0.7	17.4	0	0
	Indian Cr.	2	1	0	less than 1	0	2.2	0	0
	Jawbone Cr.	27	5	81	25	18.6	7.3	0	5.3
Middle Fork Tuolumne River	Middle Fork Tuolumne River	17	22	255	46	57.2	12.5	0	11.9
North Fork Tuolumne River	North Fork Tuolumne River	2	0	0	0	0.4	22.7	0	0
	Basin Cr.	1	0	0	0	0.4	2.1	0	0
	Hunter Cr.	9	0	0	0	0	19.9	0	0
South Fork Tuolumne River	South Fork Tuolumne River	38	29	144	24	75.8	27	0	4
Cherry Creek	Cherry Cr.	13	6	36	9	30.8	8.8	0	1.8
	Eleanor Cr.	1	0	12	22	2.5	0	0	0.5
	Granite Cr.	21	0.2	36	25	12.4	1.1	0	0.1
Clavey River	Clavey River								
	Reed Cr.	20	1	49	49	22.4	20.6	0	3.7
	Adams Gulch	15	0	0	0	1.2	1.8	0	0
	Bear Springs Cr.	18	9	0.1	20	10	0.7	0	0
	Bull Meadow Cr.	36	0	36	50	4.0	0.4	0	0.8
	Indian Springs Cr.	19	3	2	25	1.4	0.1	0	0
	Quilty Cr.	5	0	0	0	0.1	1.1	0	0
	Unnamed Tributary 1	16	3	0	8	0	2.9	0	0
	Unnamed Tributary 2	24	0	0	0	0	2.5	0	0
	Unnamed Tributary 3	69	0	26	46	0.8	10.3	0	0

Watershed (5th level Hydrologic Unit Code)	Stream name	Percent of FYLF watershed area treated, hazard tree and salvage units combined	Acres of FYLF buffer affected			Road Treatments (miles by treatment type)			
			Hazard tree	Salvage	Percent of total	Recon-struct	Maintain	New	Temporary
	Unnamed Tributary 4	48	2	1	13	3	0.7	0	0
	Unnamed Tributary 5	43	7	8	37	2.2	2.7	0	0
	Cottonwood Cr.	31	0	3	5	19.1	8.8	0	0.1
	Russell Cr.	30	0	0	0	0.9	2.3	0	0
North Fork Merced River	North Fork Merced River	2	22	18	less than 0.1	12.3	11.2	0	0.2
	Bull Cr.	2	5	0	less than 0.1	3.95	2	0	0.5
	Deer Lick Cr.	8	4	13	7	3.4	2.3	0	0.2
	Moore Cr.	4	5	5	3	2	3.8	0	1
	Scott Cr.	22	2	0	8	3.6	3.4	0	0

Western pond turtle

For the WPT, all timber removal activities (hazard tree and salvage) proposed in Alternative 4 are the same as those proposed in Alternative 3; therefore, the effects analysis for Alternative 3 applies to this alternative. There are two exceptions to this statement and they involve Big and Little Kibbie Ponds (Table 19). Under Alternative 4, the total amount of combined salvage activity would affect approximately 63 acres of the WPT buffer at Big Kibbie Pond and 29 acres of buffer area at Little Kibbie Pond. This is compared to the 86 and 54 acres proposed for treatment under Alternatives 1 and 3. The amount of activity in WPT buffers under Alternative 4 would lessen the potential for direct and indirect effects to individuals and upland habitat suitability. The lower amount of activity around these two ponds would decrease the total amount of time equipment and personnel spend in upland habitats which should decrease the potential for direct effect to any given individual. This would reduce the potential for injury, mortality, or physical disturbance.

From an indirect effect perspective, the primary difference between Alternative 4 when compared with Alternatives 1 and 3 would be an increase in LWD in upland habitats. Full recruitment potential would occur for all trees in the 25 or so acres that would not be treated. These unaffected acres would have the highest habitat suitability for the capability of the site when compared to the other action alternatives. The LWD is used by turtles as refuge habitat. There would be no detectable difference in sediment delivery to either feature when compared to Alternative 1 because the hillslopes next to these two ponds have very low gradient (less than 10 percent). Low gradient hillslopes are typically capable of retaining sediment and not transporting it downslope.

The differences in road treatment actions are discussed under FYLF and apply to the WPT at the watershed scale. The discussion of effects to FYLF habitat applies to the WPT because there is high habitat association between the two species and because the road – stream interaction occurs in a predictable way regardless of the species involved.

Table 19. Amount and percentage of western pond turtle buffer affected in salvage and roadside hazard tree units for Alternative 4.

Watershed (5th level Hydrologic Unit Code)	Stream name	Amount of WPT buffer in salvage units (percent of total buffer area treated)	Amount of WPT buffer in hazard tree units (percent of total buffer area treated)
Tuolumne River	Tuolumne River		
	Drew Cr.	27 (3%)	89 (9%)
	Jawbone Cr.	701 (22%)	102 (3%)
	Homestead Pond	15 (16%)	0 (0%)
	Three unnamed ponds	27 (10%)	4 (1%)
Middle Fork Tuolumne River	Middle Fork Tuolumne River	2113 (39%)	307 (6%)
	Abernathy Meadow	26 (20%)	6 (5%)
	Grandfather Pond	7 (9%)	2 (2%)
	Mud Lake	12 (10%)	0 (0%)
North Fork Tuolumne River	North Fork Tuolumne River	0 (0%)	411 (2%)
	Basin Cr.	0 (0%)	0 (0%)
	Hunter Cr.	0 (0%)	407 (2%)
South Fork Tuolumne River	South Fork Tuolumne River	1441 (22%)	537 (8%)
Cherry Creek	Cherry Cr.	365 (10%)	59 (2%)
	Eleanor Cr.	97 (16%)	0.1 (less than 1%)
	Big Kibbie Pond	63 (64%)	19 (19%)
	Little Kibbie Pond	29 (34%)	19 (19%)
Clavey River	Clavey River		
	Reed Cr.	438 (48%)	12 (1%)
	Cottonwood Cr.	29 (5%)	24 (5%)
North Fork Merced River	North Fork Merced River	176 (1%)	491 (3%)
	Bull Cr.	25 (less than 1%)	109 (1%)
	Deer Lick Cr.	42 (2%)	109 (5%)
	Moore Cr.	56 (2%)	60 (2%)

Hardhead

As with Alternative 3, there would be no discernible differences between Alternatives 1 and 4 for the hardhead. The direct and indirect effects discussion for Alternative 1 applies to this alternative.

CUMULATIVE EFFECTS

California red-legged frog

The cumulative effects anticipated under this alternative would be the same as those discussed under Alternative 3. The only differences between Alternatives 3 and 4 are less than one acre at any of the analysis areas.

Sierra Nevada yellow-legged frog

The cumulative effects described under Alternative 1 would apply to this alternative. For Reynolds Creek and the Middle Fork Tuolumne, there were no differences between the actions proposed under Alternative 1 and 4. For Big and Little Kibbie Ponds and Eleanor Creek, there were no cumulative actions identified in Alternative 1 that could impact individuals or habitats. Therefore, the effects of Alternative 4 would be all that would occur at these locations.

Foothill yellow-legged frog

The cumulative actions proposed under Alternative 4 were identical to those in Alternative 3 except for Cherry and Eleanor Creeks. For these two exceptions, the amount of buffer affected increased to approximately the levels in Alternative 1. The cumulative effects discussion for these two streams can be found under Alternative 1.

Western pond turtle

The types and extent of activities described in Alternative 3 are unchanged for Alternative 4 for all but two locations: Big and Little Kibbie Ponds. For the remaining locations, the cumulative effects analysis for Alternative 1 applies to the WPT in Alternative 4. At Big Kibbie Pond, there would be a reduction in cumulative percentage of buffer area affected from 88 percent in Alternatives 1 and 3 to 64 percent under Alternative 4. At Little Kibbie Pond, there would be a reduction in cumulative percentage of buffer area affected from 63 percent in Alternatives 1 and 3 to 29 percent under Alternative 4. These reductions are related to the differences in actions proposed in the alternatives rather than from cumulative sources. There would be no other actions around the ponds other than those described for Alternative 4. Cumulatively, though, there would be a lower risk of direct impact to individuals in aquatic or upland habitats with the largest reduction occurring at Little Kibbie Pond. Large woody debris supply and recruitment as a habitat element would be higher under this alternative and the habitat suitability would be high given the current capability.

Hardhead

The cumulative effects discussion for Alternative 1 applies to this alternative.

Summary of Effects Analysis across All Alternatives

Very little difference exists between the action alternatives for the California red-legged frog and Sierra Nevada yellow-legged frog because the amount of activities is very similar. For the CRLF, all three alternatives would affect the frog and its habitats in ways that are almost indistinguishable. For SNYLF at the Kibbie Ponds and Eleanor Creek areas, Alternative 4 would be slightly less impacting than Alternatives 1 or 3 because one treatment unit would be dropped and less equipment would operate in near-stream environments.

Very little difference exists between the action alternatives for most of the aquatic features assessed for the foothill yellow-legged frog and western pond turtle. There appears to be direct correlations between the amounts of salvage related activity on private and public lands and the prevalence of moderate and high vegetation severity fire. This correlation means that more severely burned watersheds have higher levels of salvage activity in addition to higher levels of post-fire watershed response. The

environmental outcomes in the high burn severity and salvage activity watersheds are similar in that there would be more activity in the upland buffer areas for the species and a greater risk of greatly increased sedimentation of aquatic habitats. These excess sediment-related effects would disproportionately decrease habitat suitability in smaller streams because they may not be as effective at mobilizing and transporting the sediment. In some cases, unsuitable habitat could occur at small spatial scales within a watershed, but, in most cases, patches of moderate to high suitability habitat would persist. Within five to seven years, the sediment transport-storage balance should be regained in most streams and more "normal" watershed processes would resume. Reproduction and recruitment may be adversely affected in some aquatic habitats and population size would be expected to decrease for up to ten years in the most severely burned and logged watersheds.

In general, the recruitment of large woody debris should only be affected to a minor degree because most streams would have extensive areas of unsalvaged forest adjacent to the water. However, some streams, like Corral, Jawbone, and Granite Creeks, could have a significant reduction in recruitment rates of LWD and these effects could persist for 150 years or more.

No 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.

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 compromised in several watersheds for up to five years. During this time period, reproductive recruitment into existing populations could decrease, but suitable habitat should be maintained for most life stages after the first year post-fire.
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. The addition of ground cover in salvaged units may function to reduce the erosion rates in high severity areas. Also, maintenance of the road system is considered to reduce connectivity to the stream network and a long-term reduction in sediment delivery from the roads is expected to decrease.

RCO 3: Ensure a renewable supply of large down logs that can reach the stream channel and provide suitable habitat within and adjacent to the Riparian Conservation Area: A reduction in recruitment rates for LWD would occur within salvage units. A management requirement for snag retention in riparian areas is intended to provide a minimum supply of LWD for channel and watershed function.

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.
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.
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 the amount and storage of pesticides within RCAs.
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: The proposed new road construction would be designed to allow for 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: Unsalvaged areas would continue to recruit CWD to channels and a management requirement is in place to ensure a long-term supply of CWD in salvage units.
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: Proposed treatments to the road system and implementation of water quality best management practices would reduce long term sediment delivery from most of the road system within the fire perimeter. Beneficial ground cover would be added in units where deficits are predicted to occur and hillslope considerations deem them necessary.

DETERMINATIONS OF EFFECT

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

The Rim Fire Recovery Project has the potential to impact individual California red-legged frogs and Sierra Nevada yellow-legged frogs directly through mortality, injury, and physical disturbance. Implementing the project would also reduce the availability of large woody debris in upland habitats for both frog species and there is the potential for project activities to produce sediment that could affect aquatic habitats in the short-term for streams and longer-term for ponds and lakes. At several locations, cumulative actions would increase the possibility for direct and indirect impacts to individuals and habitats. As such, it is my determination that the Rim Fire Recovery Project may affect, and is likely to adversely affect the California red-legged frog and the Sierra Nevada yellow-legged frog. The Rim Fire Recovery Project would not affect existing or proposed critical habitat for either species.

The Rim Fire Recovery Project has the potential to impact individual foothill yellow-legged frogs and western pond turtles directly through mortality, injury, and physical disturbance. The likelihood of direct impacts to individuals is greatest for physical disturbance, but the combination of low duration and moderate intensity mean there would be no potential for long-term physiological impacts. The project has a reasonable potential to increase sediment delivery to aquatic habitats, and, when combined with other activities occurring within affected watersheds, could reduce habitat suitability sufficiently to affect reproduction for up to two years in a few watersheds. There is a very low potential that one or more populations of the frog could be temporarily extirpated from small streams due to the impact to habitat. However, the frog and turtle remain well-distributed across the forest and within the project area. Therefore, it is my determination that the Rim Fire Recovery Project may affect individuals, but is not likely to result in a trend in federal listing or loss of viability for the foothill yellow-legged frog and western pond turtle in the planning area.

The Rim Fire Recovery Project has the potential to increase sedimentation in the Tuolumne River watershed, but deep water habitats and gravel deposits in the larger river systems (Clavey, North Fork Tuolumne, and Tuolumne) should continue to provide high quality habitat for the hardhead. There is extremely low risk of direct impacts to individuals or habitats if the project is implemented. Therefore, it is my determination that the Rim Fire Recovery Project may affect individuals, but is not likely to lead to a trend in federal listing or the loss of viability for the hardhead within the planning area.

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.

Coe, D. B. R. 2006. Sediment production and delivery from forest roads in the Sierra Nevada, California. Master's thesis. Colorado State University, Fort Collins, CO. 117p.

Dunham, J. B., M. K. Young, R. E. Gresswell, and B. E. Riemann. 2003. Effects of fire on fish populations: landscape perspectives on persistence of native fishes and nonnative fish invasions. Forest Ecology and Management 178(1-2):183-196.

Dwire, K. A. and J. B. Kauffman. 2003. Fire and riparian ecosystems in landscapes of the western USA. Forest Ecology and Management 178(1-2):61-74.

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.

Furniss, M. J., T. D. Roelofs, and C. S. Lee. 1991. Road construction and maintenance. American Fisheries Society Special Publication 19:297-324.

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.

Jockusch, E. L., D. B. Wake, and K. P. Yanev. 1998. New species of slender salamanders, *Batrachoseps* (Amphibia: Plethodontidae), from the Sierra Nevada of California. Natural History Museum of Los Angeles County Contributions in Science 472:1-17.

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.

Leips, J. and J. Travis. 1994. Metamorphic responses to changing food levels in two species of hylid frogs. Ecology 75(5):1345-1356.

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.

Neary, D. G., K. C. Ryan, and L. F. DeBano, eds. 2005. Wildland fire in ecosystems: effects of fire on soils and water. General Technical Report, RMRS-GTR-42-vol.4. U. S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, UT. 250p.

Pilliod, D. S., R. B. Bury, E. J. Hyde, C. A. Pearl, and P. S. Corn. 2003. Fire and amphibians in North America. Forest Ecology and Management 178(1-2):163-181.

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. Siepel, and D. Holland. 1992. Nesting behavior and movements of western pond turtles, *Clemmys marmorata*. Southwestern Naturalist 37(3):319-324.

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.

Robichaud, P. R., W. J. Elliot, L. MacDonald, R. Coats, J. W. Wagenbrenner, S. A. Lewis, L. E. Ashmun, and R. E. Brown. Evaluating post-fire salvage logging effects on erosion. Final Report, Proposal P06-3-4-21, Joint Fire Science Program. 22 p.

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.

Ruediger, R. and J. Ward. 1996. Abundance and function of large woody debris in Central Sierra Nevada streams. Fish Habitat Relationships Technical Bulletin, Number 20. 13p.

Semlitsch, R. D., D. E. Scott, and J. H. K. Pechmann. 1988. Time and size at metamorphosis related to adult fitness in *Ambystoma talpoideum*. Ecology 69(1):184-192.

Stafford, A. K. 2011. Sediment production and delivery from hillslopes and forest roads in the southern Sierra Nevada, California. Master's thesis. Colorado State University, Fort Collins, CO. 197p.

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.

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. 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.