EDDY GULCH LATE-SUCCESSIONAL RESERVE FUELS / HABITAT PROTECTION PROJECT

AQUATIC RESOURCES REPORT FOR WATER QUALITY AND FISHERIES

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Aquatic Resources Report for Water Quality and Fisheries

1.1 Introduction

This report summarizes the aquatic resources within the Eddy Gulch Late-Successional Reserve (LSR) Project Assessment Area and the effects on the environment that would result from taking no action (Alternative A) or from implementation of actions Alternative B or C.

Five facts are central to the analysis of the Proposed Action for the Eddy Gulch LSR Project. The first fact derives from natural elements—hot dry summers, steep slopes, and an abundance of forest growth—that create conditions that lead to frequent fires. A build up of fuels now presents serious fire risks to the resiliency of terrestrial and riparian habitats. The potential for increased fire intensity also presents risks related to soil erosion and accelerated sediment delivery to streams. The second fact is the Salmon River watershed (within which the project is located) is a designated Key Watershed (USFS 1995a), with its attendant management guidelines aimed at preserving aquatic and riparian habitats for anadromous salmonids and other riparian-dependent species. Management of Key Watersheds and LSRs emphasize habitat protection, and aquatic resources are an important part of that emphasis. Riparian Reserves, as defined in the Klamath Land and Resource Management Plan (Klamath LRMP) (USFS 1995a), receive strong protection from potential project effects. The third fact considered is the management emphasis in the Klamath LRMP on promoting and protecting late-successional terrestrial habitats. The Proposed Action has been designed to reduce fuel loadings, break up vertical and horizontal fuel continuity, and increase the forest's overall vigor and resiliency to fire. Collectively, these beneficial effects are projected to help protect and enhance existing late-successional and aquatic habitat. Fourth, most of the North Fork Salmon River and South Fork Salmon River are congressionally designated under the *Wild and Scenic Rivers Act*, a legal status precluding dam construction and placing further emphasis on management for habitat and other noncommodity values. South Russian Creek and the South Fork Salmon River above Cecilville have recommended status under the Act. The Klamath National Forest has adopted a policy through its LRMP to manage “recommended” river sections as though they were congressionally designated. The fifth fact is that there are seven municipal watersheds within the analysis area capable of supplying water to approximately 250 residents in the Salmon River subbasin.

1.1.1 Project Location

The Eddy Gulch LSR Project Assessment Area is located on the Salmon River and Scott River Ranger Districts, Klamath National Forest, in southwestern Siskiyou County. The LSR is located mostly west of Etna Summit, south of North Russian Creek and the town of Sawyers Bar, east of Forks of Salmon, and north of Cecilville. The LSR is about 61,900 acres in size, making it one of the largest LSRs on the Klamath National Forest. The LSR encompasses much of the area between the North and South Forks of the Salmon River, as well as headwaters of Etna Creek. Elevations range from 1,100 feet to about 8,000 feet. The terrain is generally steep and dissected by sharp ridges and streams. There are a few private inholdings in the LSR and along the main Salmon River and other stream corridors adjacent to the LSR.

The legal description for the Eddy Gulch LSR includes the following (all Mount Diablo Meridian):

T38N, R11W, Sections 2–5, 8–10, and 17–19
T38N, R12W, Sections 1–3, 9–16, and 22–24
T39N, R10W, Sections 2–10, 15–21, and 29–31
T39N, R11W, Sections 1–18, 20–29, and 32–36
T39N, R12W, Sections 11–14, 23–25, and 36
T40N, R10W, Sections 3–5, 8–11, and 13–35
T40N, R11W, Sections 24–27 and 34–36
T41N, R10W, Sections 2–5, 8–17, 20–24, 26–29, and 31–34
T42N, R10W, Sections 28–29 and 32–35

1.1.2 Terms

Eddy Gulch LSR — the entire 61,900-acre LSR.

Assessment Area — the 37,239-acre portion of the Eddy Gulch LSR west of Etna Summit where various treatments are proposed. All released roadless areas that occur in the LSR were excluded from planning efforts and are therefore not part of the Assessment Area.

Treatment Unit — the acres proposed for some type of on-the-ground treatment under a particular alternative.

Analysis Area — the area around treatment units considered in the effects analysis (the analysis area may be larger than the LSR Assessment Area). The analysis area varies by resource.

1.2 Summary of the Alternatives

Chapter 2 in the environmental impact statement (EIS) for the Eddy Gulch LSR Project presents more information about the three alternatives. Appendix A in this report contains project maps.

1.2.1 Alternative A: No Action

The no-action alternative is described as continuation of the current level of management and public use—this includes road maintenance, dispersed recreation (hunting, fishing, camping, and hiking), mining, watershed restoration projects, and the modeled wildfire. The time frame for analysis is considered to be 20 years. Given the fuel hazard in the Eddy Gulch LSR and current predictions of climate change, it is assumed at least one wildfire will escape initial attack during the 20-year period and burn under 90th percentile weather conditions (defined as 10 percent of the days in the historical weather database that had lower fuel moisture and higher wind speeds compared to the rest of the days). An analysis of a wildfire for three days that escaped initial attack in the Eddy Gulch LSR Project Assessment Area indicates that fire would burn 7,200 acres. Of those 7,200 acres, 1,355 acres (19 percent) would be surface fire; 5,065 acres (70 percent) would be passive crown fire; and 780 acres (11 percent) would be active crown fire.

1.2.2 Alternative B: Proposed Action

The Klamath National Forest proposes 25,969 acres of treatments to protect late-successional habitat and communities. Three primary treatment types were identified in the Assessment Area: Fuel Reduction Zones (FRZs), Prescribed Burn Units (Rx Units), and Roadside (RS) treatments along emergency access routes, which are described below.

- **FRZs**—strategically located on ridgetops to increase resistance to the spread of wildfires. The FRZs would be wide enough to capture most short-range spot fires, and ground, ladder, and crown fuels would be reduced so as to change crown fires to surface fires within the treated areas. The FRZs would provide safe locations for fire-suppression personnel to take fire-suppression actions during 90th percentile weather conditions, and they serve as anchor points for additional landscape-level fuel treatments, such as underburning.

  – ***Proposed Action*.** Construct 16 FRZs totaling 8,291 acres to increase resistance to wildfires. The 8,291 acres includes 931 acres in 42 M Units (thinning units) and 7,383 acres in fuel reduction areas (outside the M Units) to reduce ground and ladder fuels.

- **Rx Units**—a series of landscape-level treatments (ranging from 250 to 4,300 acres in size) designed to increase resilience to wildfires by reducing ground and ladder fuels. Most of these treatments would occur on south-facing aspects where fuels dry faster, and treatments would support the role of the FRZs.

  – ***Proposed Action***. Implement 17,524 acres of Rx Units to increase resiliency to wildfires.

- **RS treatments**—along 60 miles of emergency access routes identified in the Salmon River Community Wildfire Protection Plan (CWPP) (SRFSC 2007) and designed to facilitate emergency access for residents to evacuate and for suppression forces to safely enter the LSR in the event of a wildfire.

  – ***Proposed Action*.** Treat 44 miles of emergency access routes in FRZs and Rx Units (treatments would be similar to the FRZ or Rx Unit the route passes through) and 16 miles (with 154 acres of treatments) of RS treatments outside of FRZs and Rx Units—a total of 60 miles of RS treatments along emergency access routes.

Proposed Temporary Roads and Landings

The construction of new temporary roads and the use of former logging access routes are proposed to access treatment units.

- Approximately 1.03 miles (5,433 feet) of new temporary roads would be used to access all or portions of seven M Units. All of these temporary roads would be closed (ripped and mulched, as needed) following thinning.

- Approximately 0.98 mile (5,177 feet) of former logging access routes would be re-opened (vegetation removed and bladed) to access all or portions of five M Units. These routes would be water-barred and closed immediately after thinning is completed.

- Five short spurs, each less than 100 feet long, would be bladed for tractor or cable yarding operations in two units.

- Existing landings will be used (no new landings will be constructed in Riparian Reserves).

1.2.3 Alternative C: No New Temporary Roads Constructed

Alternative C responds to public concerns regarding the environmental and economic effects of constructing new temporary roads. Alternative C is similar to the Proposed Action but approximately 1.03 miles (5,443 feet) of new temporary roads identified in the Proposed Action would not be constructed. As a result, no fuels treatments would occur in portions of seven M Units. This reduces the total acres of treatments in M Units from 931 under Alternative B to 832 under Alternative C. Fuels treatments could not be carried out in those M Units because of excessive treatment costs, high existing dead crown fuel loadings, and potential heat damage to the overstory if these untreated units were prescribed burned.

Under Alternative C, the FRZs would continue to total 8,291 acres; however, 99 acres in M Units would remain untreated. The total number of acres treated by tractor yarding would remain at 361 acres; however, the acres of cable yarding would be reduced from 570 acres under Alternative B to 471 acres under Alternative C. Reducing acres of M Units treated would also reduce the number of acres treated in Rx Units 5 and 6 because excessive fuels remaining in M Units would preclude safely burning portions of those Rx Units. Rx Unit 5 would be reduced by 26 percent (418 acres) because no treatment would occur in a portion of M Unit 17, and Rx Unit 6 would be reduced by 28 percent (404 acres) because no treatment would occur in a portion of M Unit 24. Six-foot-wide control lines would be constructed around the perimeter of those untreated areas to keep prescribed burns out of those portions of Rx Units 5 and 6. There would be no changes in the miles of emergency access routes treated, transportation plan, or resource protection measures.

1.3 Significant Issue

The construction of new temporary roads was considered a significant issue during collaboration and scoping efforts. This issue centered around considerable differences of opinion concerning the need for roads to accomplish the purpose of the project and satisfy the need, and relates specifically to meeting objective 2 for the project (that is, “Objective 2: Reduce wildfire threat to communities and municipal water supplies and ensure public and firefighter safety”). Alternative C was developed in response to public concerns regarding the environmental and economic impacts of constructing new temporary roads.

1.4 Regulatory Framework

1.4.1 Klamath National Forest Land and Resource Management Plan

The *Record of Decision for the Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest-Related Species within the Range of the Northern Spotted Owl* (USDA, USDI 1994b) established the Aquatic Conservation Strategy (ACS), of which Riparian Reserves are a component. Specific direction for management of Riparian Reserves is found in the ACS and in Klamath LRMP Standards and Guidelines for Management Area 10 (Chapter 4, pages 34–36 and pages 136–144). The Standards and Guidelines are designed to protect and restore the unique functions (such as stream shade, sediment filtering, and large wood recruitment to streams) of near-stream areas and preserve their integrity.

1.4.1.1 Clean Water Act of 1972, as Amended

Forest management activities must be consistent with the federal *Clean Water Act* and the California *Porter-Cologne Water Quality Act*, as addressed in the Water Quality Control Plan for the North Coast Region. This Plan contains water quality standards that include water quality objectives and protection of applicable beneficial uses. Related to this is the imposition, by the North Coast Regional Water Quality Control Board, of a Total Maximum Daily Load (TMDL) for stream temperature. Further, projects must comply with the California Regional Water Board's Categorical Waiver for Discharges Related to Timber Harvest Activities on Federal Lands Managed by the United States Department of Agriculture, Forest Service in the North Coast Region, Order No. R1-2004-0015 (Waiver).

Clean Water Act and Best Management Practices

The most effective means to control nonpoint source pollution is through implementation of Best Management Practices (BMPs), which are defined as "methods, measures, or practices selected by an agency to meet its nonpoint source control needs." BMPs include, but are not limited to, structural and nonstructural controls, operations, and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters." BMPs are usually applied as a system of practices rather than as a single practice. BMPs are selected on the basis of site-specific conditions that reflect natural background conditions and political, social, economic, and technical feasibility. BMPs are basically a preventive rather than an enforcement system. BMPs are a whole management and planning system in relation to sound water quality goals, including both broad policy and site-specific prescriptions. Management direction specific to maintaining water quality during project implementation is contained in Appendix D of the Klamath LRMP. The BMPs were developed in compliance with Section 208 of the federal *Clean Water Act* to protect beneficial uses, such as water quality and anadromous fish, and were certified by the State Water Quality Resources Control Board and approved by the United States Environmental Protection Agency (EPA).

In 1981 the U.S. Forest Service, Pacific Southwest Region (Region 5) entered into a management agency agreement with the California Water Resources Control Board. This requires the Forest Service to institute a water quality management program to meet applicable water quality objectives and protect beneficial uses in accordance with Regional Basin Plans. The agreement allows the Forest Service to use its state-approved and EPA-certified BMPs to protect water quality from nonpoint sources of pollution and thereby meet applicable Basin Plan objectives. The agreement also requires

the Forest Service to monitor BMP effectiveness in meeting Basin Plan requirements. Specific BMP descriptions and implementation guidance are included in the Region 5 handbook titled, "Water Quality Management for National Forest System Lands in California." The project-wide guidance on BMP implementation for the Eddy Gulch LSR Project is contained in Appendix B of this Aquatics Report, and the site-specific BMPs are contained in Appendix C of this report.

1.4.1.2 The Endangered Species Act of 1973

The National Marine Fisheries Service (NMFS) has been involved in early consultation on the Eddy Gulch LSR Project as part of the streamlining consultation process. NMFS staff also participated in field trips and early interdisciplinary team (ID team) meetings. A draft biological assessment was submitted to NMFS in November 2008, and the final was approved on April 16, 2009.

1.4.1.3 National Forest Management Act

The effects analysis will include the consideration of direct, indirect, and cumulative effects on aquatic species that are United States Department of Agriculture (USDA) Forest Service Region 5 Sensitive Species and Klamath National Forest Management Indicator Species (the Management Indicator Species Report is contained in Appendix B to the Wildlife and Habitat Report for the Eddy Gulch LSR Project.

The *National Forest Management Act* (90 Stat. 2949; 16 USC 1600) states, "it is the policy of the Congress that all forested lands in the National Forest System be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designated to secure the maximum benefits of multiple use and sustained yield management in accordance with land management plans."

Chinook salmon and steelhead trout are listed as Forest Service Sensitive species in Region 5. The Klamath LRMP incorporates provisions from the Northwest Forest Plan Record of Decision (ROD) (USDA, USDI 1994a) to protect and improve conditions for aquatic species, including salmon and trout. Implementation of the ROD standard and guidelines were designed to "reverse the trend of degradation and begin recovery of aquatic ecosystems on federal lands within the range of the owl" (ROD, page 46). Section 1.9.1.7 below describes how the proposed alternatives meet the Aquatic Conservation Strategy (ACS) objectives. The ROD also addresses the matter of long-term persistence of late seral and early seral dependent species stating that, "implementation of the ROD fully meets our statutory and regulatory requirements regarding fish and wildlife resources."

1.4.1.4 The Magnuson-Stevens Fishery Conservation and Management Act

An analysis for Essential Fish Habitat is contained in the fish biological assessment / biological evaluation (BA/BE) for the Eddy Gulch LSR Project through the evaluation of effects on Chinook and coho salmon habitat. The Klamath National Forest follows the 2004 and 2001 "Guidance for Integrating Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultations, with Endangered Species Act Section 7 Consultations" (NMFS 2001a).

1.5 Methodology

1.5.1 Analysis Methods and Assumptions

The aquatic resources analysis for the Eddy Gulch LSR Project has five basic components: (1) a review of known information; (2) thorough examination of aerial imagery; and (3) field review of proposed treatment units, Riparian Reserves, current water uses, and areas of sensitivity; (4) application of the Klamath National Forest Cumulative Watershed Effects (CWE) model to assess aggregated effects of the Proposed Action and alternatives to the risk of sediment delivery to streams through surface erosion and landsliding and potential change in flow, and (5) use of the Water Erosion Prediction Project (WEPP) model to estimate the magnitude of post-wildfire surface erosion rates.

Source of Known Information

The sources of known information on watersheds in the Assessment Area, fisheries and their habitat, land uses, conditions of roads, stream surveys, and stream temperature data include the following:

- Klamath LRMP (USFS 1995a);
- Klamath National Forest Forestwide Late-Successional Reserve Assessment (forestwide LSR assessment) (USFS 1999);
- Salmon River CWPP (SRFSC 2007);
- Salmon River Subbasin Restoration Strategy: Steps to Recovery and Conservation of Aquatic Resources (USFS 2002c);
- Klamath National Forestwide Roads Analysis (USFS 2002b);
- Main Salmon Ecosystem Analysis (USFS 1995b);
- North Fork Salmon Ecosystem Analysis (USFS 1995c);
- Lower South Fork of the Salmon River Ecosystem Analysis (USFS 1997b);
- Upper South Fork Salmon Ecosystem Analysis (USFS 1994b);
- Salmon River Restoration Council; and
- Klamath Resource Information System (KRIS) website (http://www.krisweb.com/).

Aerial Imagery

Aerial imagery was used to identify sensitive watershed areas such as active landslides, active surface erosion, and stream channels undergoing scour and enlargement. Information collected in this phase was used to focus the field review of areas outside of or adjacent to the proposed treatment units.

The field review included the following elements:

- **Traverses of all proposed thinning units where ground-based yarding or fuel treatments are proposed.** Each traverse involved the establishment of a Global Positioning System (GPS) reference point, collection of representative photographs, soils and geologic information, slope gradient, proximity of Riparian Reserves, areas of special sensitivity (slumps, seeps), recommendation for applicable BMPs, and a qualitative impact rating based on site sensitivity and proposed treatment. Field traverses were also conducted on 50 percent of proposed cable units and 25 percent of units where prescribed fire was the only proposed treatment.

- **Field review of the most actively unstable areas in or near proposed treatment units.** The objective of this review was to look for correlations between slope failure and geology, geomorphology, and disturbance.

- **Collection of information on erosion or drainage problems on existing roads.** Where such problems were encountered, a GPS reference point was collected, along with notes on the nature and magnitude of the problem and possible solutions.

- **Stream survey of selected stream reaches to validate and supplement existing information on channel type, channel stability, pool frequency, sedimentation, and stream temperature.** These surveys were limited in geographic extent, intended only to provide a current snapshot of channel conditions. Survey sites were selected based on the clustering of proposed treatment units and the extent of past watershed disturbance.

- **Field review of Riparian Reserves with proposed treatments.** The objective of this element was to field review the condition of Riparian Reserves where there may be potential effects from proposed actions.

Cumulative Watershed Effects Model

The CWE model tracks watershed disturbance and management activities to gauge the relative risk of impairing watershed functions (such as infiltration) that can then produce secondary off-site effects. The CWE model used by the Klamath National Forest has three components. The reader should carefully consider that CWE model results are not actual effects. For areas where the model produces high risk ratios (near or above 1.0), the implication is that closer scrutiny and/or more conservative treatments may be appropriate to reduce risk and uncertainty about potential effects.

1. The “Equivalent Roaded Acre” (ERA) component tracks acres of soil disturbance by converting all disturbances to the common currency of an ERA. As such, the model is essentially an accounting procedure for the creation of impervious surfaces in the watershed under analysis.

2. The GEO component looks at the potential for the generation of sediment from management-induced landslides. It is based on an analysis (conducted by geology staff of the Klamath National Forest) of landslide-supplied sediment in the larger Salmon River basin.

3. The third component is based on the Universal Soil Loss Equation (USLE) and models project effects on surface rill and gully erosion. Part of the input to the CWE model comes from assessments of potential effects (unit-by-unit and road-by-road) that are generated by the field review. The selection of erosion rates and other coefficients in the model is largely guided by those assessments and by intrinsic site factors like slope, soils, and proximity of known instability.

Water Erosion Protection Project

WEPP is a soil erosion prediction model developed by the National Soil Erosion Laboratory of the USDA Agricultural Research Service. It uses soil, topography, and climate data to predict soil erosion rates and probabilities of sediment delivery to streams. The U.S. Forest Service has participated in the development of online WEPP interfaces with special applicability to western forests and climates. The Forest Service WEPP interface was used in this application.

1.5.2 Scope of the Analysis

Analysis Area

The Eddy Gulch LSR is within the Salmon River basin on the Klamath National Forest. The LSR is approximately 61,900 acres in size and lies primarily within tributary watersheds (7th-field hydrologic units) between the North Fork (5th-field hydrologic unit) and South Fork (5th-field hydrologic unit) Salmon River. A small portion of the LSR (6,771 acres) overlaps into the headwaters of Etna and Mill creeks (6th-field hydrologic units), tributary to the South Fork Scott River (5th-field hydrologic unit).

With the exceptions noted below, the analysis area includes all areas within the 7th-field watersheds in which project activities are proposed, and areas downstream that could be affected by proposed activities. These watersheds are listed in Table 1. Because the proposed FRZs tend to drape across ridges as a matter of their design, a few of the 7th-field watersheds make the list but actually contain very small acreages of treatment. Three of the twenty 7th-field watersheds (Kanaka-Olsen, Robinson-Rattlesnake, and Upper Etna) have proposed treatments covering less than 20 acres. In each instance, the proposed treatments involve a low-impact combination of underburning and mastication. These three watersheds are included in the CWE analysis (Appendix D of this report) but will not be discussed further in this document because fisheries biologists and hydrologists determined that these activities would have no effect on water quality, aquatic species, or their habitat. All twenty 7th-field watersheds are shown in Table 1.

The 7th-field watersheds listed in Table 1 are within three 5th-field watersheds (North Fork Salmon River, South Fork Salmon River, and the South Fork Scott-French). The main streams within these 5th-field watersheds are part of the affected environment because water quality and aquatic habitat in the LSR is hydrologically linked to these downstream areas. The South Fork Scott-French watershed contains less than 1 acre of treatment area within the Upper Etna 7th-field watershed. For the same reasons cited earlier (minimal acreage proposed, resulting in no effect on water quality, aquatic species, and their habitat) for the Upper Etna watershed, the South Fork Scott-French 5th-field watershed is not analyzed further in this document.

Table 1. Analysis area 7th-field watersheds, proposed treatment acres, and miles of fish-bearing streams.

7th-Field Watershed	Proposed Treatment Acres	Miles of Fish-Bearing Streams
Black Bear Creek	5,217	4.3
Cody-Jennings	1,577	5.3
Crawford Creek	6,600	4.2
Eddy Gulch	1,022	2.7
Gooey-Ketchum	86	4.8
Gould-East Fork, South Fork Salmon River	974	0.5
Indian Creek	82	1.0
Lower North Russian Creek	1,006	4.7
Lower South Russian Creek	461	2.2
Matthews Creek	1,799	1.5
Shadow Creek	5,064	1.9
Sixmile Creek	441	2.5
Tanner-Jessups	89	2.6
Taylor Creek	683	0.0
Timber-French	204	7.1
Upper North Russian Creek	1,011	1.2
Whites Gulch	574	1.6
Kanaka-Olsen	18	3.6
Robinson-Rattlesnake	2	4.6
Upper Etna	0.02	1.1

In summary, in addition to the 7th-field watersheds listed in Table 1 above, the following 5th-field watersheds are also within the analysis area because aquatic habitat in the LSR is hydrologically linked to downstream areas:

- North Fork Salmon River
- South Fork Salmon River
- South Fork Scott-French

Analysis Period

Relative to vegetation recovery and soil cover, short-term effects refer to 0–5 years and long-term effects refer to longer than 5 years. Relative to sedimentation and streams, short-term effects refer to pulse effects that subside almost immediately and long-term effects refer to chronic effects.

1.5.3 Definitions for Terms Used in this Report

Entrenchment ratio — A measure of channel confinement during flood flows. Values greater than 1.5 indicate presence of a stream terrace or floodplain.

Large woody debris (LWD) — LWD (logs) that are present in the bankfull channel and hydraulically significant in altering flow direction and velocity.

Residual pool volume — The volume of water that would remain in a pool at zero flow.

Stability rating — A rating system to gauge a stream's susceptibility to scour. It evaluates physical and vegetative conditions on upper and lower stream banks and wetted channels.

Substrate fines — The percentage of substrate particles less than 2 millimeters (mm) in diameter as determined by an extractive core sampling method.

Surface fines — The percentage of substrate particles less than 2 mm in diameter as determined by a grid tally on the surface of pool tail outs.

V* — The percentage of residual pool volume occupied by fine sediment. Another measure of stream sedimentation (Hilton and Lisle 1993).

Width/depth ratio — An index of channel form. Values greater than approximately 12–15 are indicative of wider, shallower streams.

1.5.4 Intensity of Effects

"Intensity" refers to the severity of effects or the degree to which the action may adversely or beneficially affect a resource. The intensity definitions used throughout the effects analysis are described below.

No Effect. The appropriate conclusion when it has been determined the Proposed Action will not affect species or their habitat.

Negligible or Discountable. The appropriate conclusion when effects on species or their habitat are expected to be discountable (extremely unlikely to occur) or insignificant.

Minor. Chemical, physical, or biological changes to water quality and hydrology would be detectable in and/or immediately adjacent to treatment units but would be well below limits set by state and federal water quality standards or criteria and would be within historical or desired water quality and hydrologic conditions.

Moderate. Chemical, physical, or biological changes to water quality and hydrology would be detectable downstream of treatment units but would not be detectable in 5th-field receiving streams. Any changes would be at or below limits set by state and federal water quality standards or criteria. Water quality and hydrology would be altered compared to historical baseline or desired water quality and hydrologic conditions.

Major. Chemical, physical, or biological changes to water quality and hydrology would be readily measurable in 5th-field receiving stream and would be frequently altered from the historical baseline or desired water quality and hydrologic conditions. Chemical, physical, or biological water quality standards or criteria would be periodically exceeded.

1.5.5 Measurement Indicators

Table 2 lists the indicators used for assessing effects on water quality and aquatic habitat and for addressing the significant issue of temporary road construction. The indicators were also used for determining if the Proposed Action is responsive to the purpose and need for the Eddy Gulch LSR Project as related to water quality.

Table 2. Measurement indicators for aquatic resources.

Indicator	Resources	Reason
Sediment delivery to streams as measured by CWE model risk ratios (all components)	Water quality and fisheries	Changes in sediment delivery rates can affect downstream aquatic resources (channel morphology and fish habitat).
Flood regime change as measured by CWE model risk ratio (ERA component)	Water quality	Changes in flood regime can affect channel morphology and fish habitat.
Stream (water) temperature, measured by percent of stream shade	Water quality and fisheries	Increases in water temperature can affect fish survival. Reduction of shade over a stream can cause increases in stream temperature.
LWD as measured by predicted effects on Riparian Reserves	Water quality and fisheries	Reduction in LWD in Riparian Reserves can reduce filtering capacity and fish habitat complexity in the long term.
Road density	Water quality and fisheries	Increased road density is linked to changes in sediment delivery to streams. This Indicator also responds to the significant issue (construction of temporary roads) identified through scoping.

1.6 Affected Environment (Existing Conditions)

1.6.1 Fisheries

The following Pacific salmonid Evolutionarily Significant Units and their habitat occur in the area affected by the Proposed Action:

Endangered:	None
Threatened:	Southern Oregon Northern California Coasts (SONCC) coho salmon
Critical Habitat:	SONCC coho salmon
Proposed:	None
Sensitive:	Upper Klamath-Trinity (UKT) Chinook salmon; Klamath Mountain Province (KMP) steelhead
Essential Fish Habitat:	SONCC coho salmon; UKT Chinook salmon
Management Indicator Species:	Steelhead; resident rainbow trout

Map A-5 in Appendix A of this report shows the distribution of salmonids in the analysis area. Conclusions regarding anadromous fish and their habitat (including critical habitat) occurrence are based on field review of habitat suitability, professional judgment, District fish survey records, and California Department of Fish and Game (CDFG) information. Field surveys, CDFG information and professional judgment of fisheries biologists was compiled into the Klamath National Forest

steelhead trout distribution layer in their Geographic Information Systems (GIS) electronic library. The steelhead trout distribution over-estimates the extent of coho salmon, critical habitat, Chinook salmon, and Pacific salmon Essential Fish Habitat, except where site-specific field surveys refine Chinook salmon, coho salmon, and critical habitat distribution (such as the habitat is found to be inaccessible for coho salmon, Chinook salmon, or both). The Klamath National Forest considers the use of their Steelhead Trout Distribution Layer to define Chinook salmon habitat, and coho salmon critical habitat, as a conservative (inclusive) approach for assessment of effects on coho and Chinook habitat (including critical habitat) because coho and Chinook salmon may not occupy the same waters as steelhead due to the differences in jumping abilities. The maximum jumping height for coho is approximately 2.2 meters (7 feet), Chinook salmon is 2.4 meters (8 feet), and steelhead is 3.4 meters (11 feet) (Meehan 1991).

North Fork Salmon River

The North Fork Salmon River (5th-field watershed) is one of two major forks of the Salmon River and is part of the National Wild and Scenic River System. The North Fork Salmon River provides habitat for the Klamath River's largest wild run of spring Chinook, as well as KMP summer-run steelhead. These wild Salmon River runs are unaffected by hatchery-produced salmonids because there are no fish hatcheries in the Salmon River basin. The watershed is comprised of approximately 130,200 acres. Approximately 1 percent of the watershed is privately owned, and the remainder is federal land managed by the Klamath National Forest. The forest manages 43 percent as wilderness, and the remainder is managed for other resource values.

The North Fork stream lacked coarse woody material, fine sediment was a problem, embeddedness was high, and there was a lack of pool habitat (USFS 1995c). The North Fork of the Salmon River met desired pool frequency in two out of 17 reaches surveyed and did not meet fine sediment in the lowest seven reaches, which are below Little North Fork. Water quality, including water temperature, is a concern in the Salmon River basin. Shade is lacking along the entire North Fork of the Salmon, with the exception of the upper-most reaches. Tributary temperatures were below lethal levels. The Little North Fork had the largest cooling effect on the North Fork of the Salmon River due to its significant flow contribution. The North Fork of the Salmon River exceeds maximum recommended temperatures (below 70ºF) during the summer. High water temperatures have resulted in fish kills of spring-run Chinook salmon and summer steelhead during warm low-flow drought conditions of some summer seasons, such as in 1994.

Approximately 29 percent of the watershed is designated as Riparian Reserves, which include unstable or potentially unstable lands and stream buffers. Current conditions and uses of Riparian Reserves are related to historic uses, which have included grazing, roads, stream crossings, and mining. Analysis of the 1944 air photos showed that at that time, most stream channels were fully vegetated with a mixture of conifer and hardwood species. The 1964 flood resulted in major changes to the stream channel in that the channel widened and long segments were scoured out. The entire length of the North Fork of the Salmon River was modified and stripped of riparian vegetation. For context, there were 8 miles of freshly scoured channels visible on the 1944 air photos, 40 miles of freshly scoured channels on the 1965 photos, and 12 miles of freshly scoured channels on the 1975 photos. Recovery from debris and other scour events occur in stages and along variable timelines. Full recovery of large conifers may take 100 years or more, although initial recovery of short-lived riparian species that also provide bank stability and integrity can occur in a decade or two. In 1995 the

Klamath National Forest estimated that the main stem North Fork of the Salmon River showed 20 percent initial recovery since the 1964 flood. This may be because, in general, larger streams recover more slowly than smaller streams (the Klamath National Forest also studied recovery of smaller streams) due to larger surface areas affected by scour and larger streamflows acting on this surface. Unstable areas and disturbed streams that have poorly defined primary channels may recover slowly due to frequent re-disturbance by subsequent high flow events.

Significant portions of Riparian Reserves were burned in the past with moderate to high severity by the Hog, Yellow, and Specimen fires. Riparian vegetation recovery to a mature state within granitic terrains takes approximately 80 years (to re-establish large conifers).

In addition to fires, landsliding is a significant watershed process of concern in the North Fork Salmon River. Roads and harvest in granitic soils, road density, and fire are concerns relative to increasing landslide potential in this watershed. During the Twentieth Century, 75 percent of the landslide-derived sediment, which entered the stream, was associated with flood and storm events that occurred from 1964 to 1975. Roads produced landslides at a rate much higher than undisturbed lands. Harvested or burned areas produced landslides at a rate much lower than roads but higher than undisturbed lands.

The CDFG estimated spawning populations in the Salmon River for a five-year period—population estimates ranged from 1,000 to 4,000 (CDFG 1994 *in* USFS 1995c). The North Fork of the Salmon River "holding" summer steelhead population estimates for the period of 1980 through 1994 were less than 75 individuals per year observed. The North Fork of the Salmon River "holding" spring-run Chinook salmon populations for the same time period ranged from 3 to 363 individuals. On average, 25 percent (of total observed from 1980 through 1994) of spring-run Chinook salmon and summer steelhead were in the main stem Salmon River and 20 percent in the North Fork of the Salmon River. These surveys also showed that 75 percent of adult spring-run Chinook salmon and summer steelhead holding in the North Fork of the Salmon River use the reach, which extends from the mouth of the North Fork of the Salmon River to the Little North Fork, and on average, 94 percent of the Chinook salmon spawning occurs in the same reach.

South Fork Salmon River

The South Fork Salmon River (5th-field watershed) provides important habitat for native fish, including steelhead, spring and fall-run Chinook salmon, coho salmon, Pacific lamprey, sturgeon, dace, Klamath small-scale sucker, and sculpin. The South Fork Salmon River is important refugia for the last remaining wild-run spring Chinook salmon in the Klamath River basin and provides important holding and spawning habitat for summer steelhead.

Watershed conditions have been impacted by fires, roads, and historic timber harvest practices associated with mining. Wildfire is probably the largest single disturbance affecting watershed conditions in the lower South Fork. Subwatersheds in the lower South Fork considered as Areas With Watershed Concern (AWWCs) include Indian Creek, and Black Bear Creek. The original road system was developed to provide access to gold mines and later was extended for timber harvest. Inner gorges are found along streams in all parts of this watershed and have naturally high debris slide rates. Debris sliding, surface erosion, and channel erosion all contribute sediment to streams. Flooding with debris torrents have occurred and have triggered debris slides and torrents. The Klamath National Forest rated large wood as sparse in most reaches. Summer water temperatures are

a concern in the lower South Fork, which has low shade values due to the width of the stream and bedrock dominated terrain. The lower South Fork has had high turbidities attributed to landsliding in the wilderness headwaters of the upper South Fork watershed.

The 7th-field watersheds in the Eddy Gulch LSR are described below in the context of existing conditions of the three habitat indicators selected for this analysis: sediment, temperature, and LWD.

1.6.1.1 Sediment

The Klamath National Forest rates many of the 7th-field watersheds in the Eddy Gulch LSR as being "at risk" for the sediment indicator, which means that the amount of fine sediment was higher than desired, and/or cobble embeddedness was 20 percent or greater, or watersheds had relatively high CWE ratings. Crawford Creek and Black Bear Creek were rated at "properly functioning" for sediment. The following watersheds were rated as "at risk" for watershed disturbance history (see checklists in the BA): Shadow Creek, Taylor Creek, Crawford Creek, Mathews Creek, Black Bear Creek, Upper North Russian Creek, Lower North Russian Creek, Lower South Russian Creek, Whites Gulch, and Eddy Gulch.

Disturbances

Sediment delivery to streams occurs through the action of surface runoff and landslides. Natural sediment regimes follow the pattern of punctuated equilibrium. This is characterized by long periods of relatively low rates of sediment delivery interrupted by sudden, massive inputs of sediment brought about by high-severity wildfires, major flood events, earthquakes, or combinations of similar factors. Human disturbances (such as roads, timber harvest, and mining) tend to increase sediment delivery during the intervening period between catastrophic events.

Landslides. Erosion potential and landslides create a spatially variable sediment supply to channels at the reach scale. There is also likely significant variability in natural sediment supply at the subbasin scale. Thus, in combination with heterogeneous channel and valley floor morphology, results in a high degree of variability in sediment storage and transport. Channel and valley morphology (steep, structurally controlled slopes within narrow valleys) in the Eddy Gulch LSR have the greatest influence on fish habitat, including channel gradients, wood storage, gravel availability / storage, and fine sediment distribution. Stream channels in the LSR are primarily moderate to high gradient, boulder dominated, step / pool beds with high energy and confined within steep inner gorges. Thus, these streams have low sedimentation potential (that is, sediment accumulation potential) due to gradients and generally confined channel conditions that result in high stream power and transport of sediment downstream. Fish habitat (such as pools and spawning substrate) is periodically and frequently reset due to sediment inputs from streamside landslides and debris flows. These are the dominant natural landscape processes relative to sediment that drive existing conditions of fish habitat in the LSR.

Within the analysis area, there is ample evidence of old (now dormant) landslides. Many mapped landslide features are 50 or more years old ("dormant slides" can be much older) judging from the approximate age of stable trees growing on them. Most of these landslides are of the slump / earthflow type. Landslides that are currently mapped and labeled as "active" are not necessarily active in the sense of currently showing evidence of active movement (some are and some are not).

Recently active slides with clearly visible scars (head scarps, ground fracture, debris chutes) are much less abundant. Four debris slides have occurred in upper Eddy Gulch (T39N, R11W, Sec 8) in the aftermath of the 1997 flood year. The largest of these is approximately 10 acres in size. Another recent slide, found in Crawford Creek, originated in over-steepened fill material from an old landing (T39N, R11W, Sec 33). A few small slump / earthflow features were found along the "switchback" portion of National Forest System road 39N20 outside the Assessment Area boundary but within the Shadow Creek drainage.

Floods. Floods have been a dominant disturbance process that periodically affect fisheries habitat. Major floods occurred in the Salmon River basin in 1861–1862, 1889–1890, 1953, 1955, 1964, 1970, 1971, 1974, and 1997 (Elder et al. 2002), and these events corresponded with landsliding, which produced sediment to stream channels. The 1964 flood resulted in major channel widening. The flood of 1997 resulted in loss of pool depths and riparian vegetation.

The most vulnerable rock types from the standpoint of mass movement and surface soil erosion are highly weathered granodiorites (coarse-grained igneous rock) and the unconsolidated sedimentary deposits formed from them. Only South Russian Creek has significant areas in this rock type, and none of it lies within areas planned for project activities. Incredibly destructive debris torrents are the most common mass movement in this rock type. South Russian Creek experienced just such an event in the aftermath of severe thunderstorms in 1996.

Surface soil erosion potential is a function of intrinsic soil properties (texture, structure, and shear strength), slope steepness, and cover. The soils formed from the dominant metamorphic rocks tend to be very gravelly loams with fairly well-developed structure. As result, high soil erosion potential is mostly associated with slope steepness. Detailed information on soils can be found in the "Soils Report" for the Eddy Gulch LSR Project.

Riparian Reserves are components of the landscape that are critically important to protection of aquatic resources, either because of their proximity to streams or their special sensitivity to disturbance. Riparian Reserves may be thought of as falling into two subtypes: "wet" Riparian Reserves are streams and other water bodies and their adjacent riparian zones; generally, "dry" Riparian Reserves are areas of past or present slope instability. Both types of Riparian Reserves are protected through application of Standards and Guidelines described in the Klamath National Forest LRMP and are managed to meet ACS objectives (that is, to maintain and restore functions).

Roads. Road density is considered "properly functioning" in a watershed if there are less than 2 miles per square mile (mi/mi^2) of roads, with no valley bottom roads. Road density in the Eddy Gulch LSR varies. For example, lower North and South Russian creeks, North Fork Salmon River, North Russian Creek, Gould-East Fork South Fork Salmon, South Fork Salmon River, Taylor Creek, Upper North and South Russian Creek watersheds all have road densities that are rated as "properly functioning." Mathews Creek, Shadow Creek, and Whites Gulch are rated as "at risk" for road density, and Eddy Gulch is rated as "not properly functioning" for road density (road density is 4.44 mi/mi^2). Eddy Gulch and Mathews Creek both have main roads that parallel the stream for a considerable distance.

Table 3 presents a summary of road development in Riparian Reserves by 7th-field watersheds. Ten of the 17 listed watersheds have road densities above 2.0 mi/mi^2. Fifteen of the 17 listed watersheds have road densities in Riparian Reserves above 2.0 mi/mi^2; some are much higher. This is generally the result of historically built roads that parallel streams. Road density is greater in Riparian Reserves than in watersheds, in some instances, due to the greater proportion of roads in the relatively smaller area of Riparian Reserves.

Table 3. Summary of past road development by 7th-field watershed.

7th-field Watershed	Road Density in Riparian Reserve (mi/mi^2)	Road Density in Watershed (mi/mi^2)
Black Bear Creek	1.9	2.7
Cody-Jennings	2.8	1.4
Crawford Creek	2.9	3.1
Eddy Gulch	5.2	4.5
Gooey-Ketchum	4.0	1.9
Gould-East Fork South Fork Salmon	2.5	2.0
Indian Creek	2.4	3.2
Lower North Russian	4.3	1.7
Lower South Russian	6.4	3.6
Matthews Creek	3.5	2.7
Shadow Creek	1.8	2.7
Sixmile Creek	2.2	1.7
Tanner-Jessups	4.6	3.2
Taylor Creek	2.3	1.7
Timber-French	3.1	1.6
Upper North Russian	3.8	2.6
Whites Gulch	3.3	2.2

Changes in sediment regimes were assessed using the CWE predictive models or estimates of stored sediment in stream channels. Both are employed in this report to describe existing sediment delivery regimes.

Cumulative Watershed Effects Model

The Klamath National Forest's CWE model (Appendix D in this report) has two components that address sediment delivery potential. The USLE component uses a long-established predictive algorithm to estimate changes in rates of rill and gully erosion and its delivery to streams. The GEO component predicts sediment delivery from potential landslide events based on disturbance history and site geology and geomorphology. The CWE model's current condition assessment is described below. The model output reports risk ratios. Risk ratios are the result of dividing the parameter of interest (sediment yields from the USLE component is an example) by the threshold of concern (TOC) established by assessing watershed sensitivity. It is a type of normalizing such that the critical value of the risk ratio is 1.0. Watersheds are judged to be well below TOC when risk ratios are well under 1.0.

The CWE model, USLE component, identifies two 7th-field watersheds as being near or over threshold for sediment delivery from surface runoff: Eddy Gulch (risk ratio = 1.05) and Shadow Creek (risk ratio = 0.94). All other 7th-field watersheds have risk ratios between 0.24–0.56, indicating

that these watersheds meet desired condition. The GEO component identifies four 7th-field watersheds with potential concerns over landslide-related sediment delivery: Upper North Russian (risk ratio = 0.87), Indian Creek (risk ratio = 0.87), Eddy Gulch (risk ratio = 0.79), and Kanaka-Olsen (risk ratio = 1.53).

As mentioned previously, another means of making inferences about sediment regimes is by examining stored sediment in stream channels. Stream channels in 7th-field watersheds exhibit fairly similar morphological characteristics. These characteristics include high gradient (4–10 percent), boulder–cobble substrates and summer maximum water temperatures below 60°F. Pools are relatively small due to the role of boulders in the creation of step-pool reaches. The extent of response reaches, which are low-gradient reaches that would typically store sediment, in the subject 7th-field watersheds is extremely limited or absent in some streams as supported by past survey data, and quantitative and reconnaissance surveys conducted in 2008. Two reaches were surveyed in August of 2008: Shadow Creek below the confluence of its two branches and Crawford Creek, also below the confluence of its two branches (Table 4). Shadow Creek was selected because of its fairly high road density and abundance of plantations. Crawford Creek was selected because of the clustering of proposed treatment units in the watershed and the domestic use of its waters by residents of Cecilville. The results of those surveys are shown in Table 4. The results are entirely consistent with the general description of 7th-field channels given above.

Table 4. Summary of 2008 stream surveys in Shadow and Crawford creeks.

Stream Attribute	Shadow Creek	Crawford Creek
Gradient	6.9%	5.5%
Width / Depth Ratio	9.94	12.61
Entrenchment Ratio	1.63	1.84
V*	13.8%	12.1%
Shade	83%	88%
Channel Stability Rating (Pfankuch)	56—GOOD	58—GOOD
Mean Temperature (°F)	57.5	57.4
Dominant Substrate	Boulder–Cobble	Boulder–Cooper
Dominant Vegetation	Mid-successional	Mid-successional
Large Woody Debris[a]	97.8	39.6
Snags[b]	39.1	9.9
Channel Type	A2-A3 Transport/Step Pool	A2-A3 Transport/Step Pool
Pool Characteristics		
Average Maximum Depth (feet)	1.53	1.65
Average Residual Volume (cubic feet)	80.69	146.43
Pool Frequency[c]	7.8	7.6

Notes:

a. Defined as hydraulically effective single pieces or aggregates with at least one end within the bankfull cross section (number per mile of stream).

b. Defined as standing dead snag larger than 20 inches diameter at breast height (dbh) within one tree height of channel (number per mile of stream).

c. Average number of channel widths between pools.

There is one caveat concerning the data shown in Table 4: the fine sediment (ordinarily defined as particles 2 mm or less) encountered in these channels was comprised of an unconsolidated, poorly sorted mix of coarse sand and fine gravel up to approximately 1 centimeter (0.4 inch) in diameter. Silt and clay fractions were minimal. Also, much of the fines were not accumulated in pool tails but

occurred, instead, downstream of mid- and side-channel boulders. The slightly elevated values for stored sediment volume in pools (V*) can be misleading since a high proportion of the “fines” were coarser than 2 mm. Rather than being a detriment to spawning habitat, these unconsolidated deposits can provide spawning habitat in channels otherwise dominated by cobble and boulder-size particles, which are much too large to serve as spawning substrate for resident trout or steelhead. These data are consistent with qualitative assessments of other 7th-field tributaries at road crossings and other access points. In-channel evidence for large amounts of fine sediment is not present. The 7th-field tributaries are high-gradient transport channels that could be flushing fine sediments through to mainstem channels. These data are presented for consideration even though their value in estimating the status of sediment delivery regimes is limited by the factors discussed above.

Flood Return Intervals

The amount of impervious area increases within a watershed when a higher proportion of precipitation and snow melt takes rapid, overland flow paths rather than infiltrating into the soil. If this runoff does not encounter infiltration opportunities along its flow path, it rapidly reaches the main channel. Under the right circumstances, and with sufficient impervious area, the magnitude of short return-interval flood peaks can increase, leading to channel scour. Limiting impervious area is the primary mitigation for this impact. It is exactly this condition that is indexed by the ERA component of the Klamath National Forest's CWE model.

Of all the 7th-field watersheds in the Assessment Area, only Indian Creek is near or over threshold (risk ratio = 1.04). The next highest risk ratio is for Lower South Russian (0.54). The existing condition in the Assessment Area, overall, poses little concern over altered flood regimes and its associated secondary effect of channel scour. The potential for channel scour is also judged to be low by virtue of highly armored boulder-cobble channels characteristic of the area’s 7th-field tributaries.

The Salmon River CWPP identifies the following 7th-field drainages as municipal watersheds based on their existing or potential use as sources of domestic water supply; Black Bear, Eddy Gulch, Callahan Gulch, Crawford Creek, Shadow Creek, Counts Gulch, and Music Creek. No evidence was found to indicate that current levels of sediment storage or transport adversely affect these uses.

1.6.1.2 Large Woody Debris

Large wood is one of the primary watershed products the Eddy Gulch LSR supplies and replenishes to downstream aquatic / anadromous salmonid habitat. The predominant mechanism for large wood recruitment in the LSR is streamside landsliding with some mass wasting. Thus, the level of recruitment depends on the availability of large conifers on inner gorges. Wood transport downstream occurs via debris torrents and large flood events, such as the 1997 flood, which resulted in numerous landslides. The primary functions of large wood include pool formation, cover, nutrient input, and sediment storage and metering. In addition to habitat complexity, large wood jams can force stream flows underground to contact the hyporheic zone, which can help cool stream temperatures. Large wood in headwater areas may also prevent headward erosion of gullies and stream channels. Relative to anadromous salmonid habitat, pool formation, cover, and sediment storage functions generally occur in relatively low-gradient channels with deformable gravel beds, more typical of lower reaches of tributaries and main stem habitat outside of the LSR. Within the steep tributaries (including fish-bearing streams) in the LSR, large wood was often observed

suspended above the active channel during summer low flows due to channel characteristics that include narrow incised channels with boulder substrates. Large wood trapped in step pools provided important cover and was relatively stable.

Field survey results rated Eddy Gulch, Mathews Creek, Crawford Creek, Black Bear Creek, and Whites Gulch as "at risk" based on low amounts of large wood documented in the bankfull channel. An abundance of small to mid-size diameter wood pieces was observed during field reviews of these streams, generally reflecting the size of trees in Riparian Reserves. LWD levels have been reduced by past disturbances, including the 1964 flood, which scoured and transported large wood out of these stream systems; and past fires and timber harvest, which reset vegetation in Riparian Reserves. Lower North Russian, Lower South Russian, Music Creek, North Russian Creek, Shadow Creek, Sixmile/Gould, Taylor Creek, and Upper North and South Russian creeks are all rated as "properly functioning" for LWD, which indicates they have more than 80 pieces of large wood (defined as dbh larger than 24 inches and longer than 50 feet) per mile.

As discussed above, the condition of Riparian Reserves is a primary influence on water quality and fisheries habitat and is discussed in this section. Many of the streams in the Eddy Gulch LSR have narrow, deeply incised channels with a minor component of obligate riparian vegetation. Debris torrents and channel scour associated with flood events are common occurrences and periodically reset streamside vegetation that is immediately adjacent to streams. Willow, big leaf maple, and alder colonize these disturbed areas and are critical for recovery of riparian function and for input of nutrients. Conifers, and in many stream reaches, steep incised topography, provide the primary stream shade in Riparian Reserves in the LSR. In addition, conifers provide the bulk of large wood and root stability to streamside areas in the LSR. However, the LSR also has a number of acres that are on south- and west-facing slopes with shallow soils and hot, dry conditions, which are not conducive to dense coniferous stands.

During field surveys of 7th-field watersheds, riparian vegetation was observed to be a mosaic of mostly mid-successional, with some late-successional characteristics. Large trees were usually present but not predominant. Road incursions, salvage logging, fire, floods, and old landslides are the agents that have produced earlier successional patterns in riparian stands.

Even though all riparian stands may not be at full potential relative to late-successional characteristics, stream shade is abundant. Where past disturbance has removed conifer canopy, riparian hardwoods (alder, big leaf maple, dogwood, and willow) have rapidly filled the gap. With the exception of road crossings, shade canopy was observed to be over 80 percent and often near or above 90 percent.

At higher elevations, some of the hardwood component disappears in favor of brush species with lower water demand. As such, the component of shade provided by non-coniferous vegetation declines, as does overall shade. At elevations above about 4,500 feet on intermittent channels, shade values were observed to be more commonly in the 60–70 percent range.

Except where permanent roads are located in or near riparian zones, ground cover was observed to be almost always at or near 100 percent in Riparian Reserves. As a result, the sediment filtering capacity of most Riparian Reserves is very good. The specific areas where road incursions have

impacted the sediment filtering capacity of Riparian Reserves include South Russian Creek (road 40N54), Whites Gulch (40N61), Black Bear Creek (1E001), and lower Crawford Creek (39N23).

1.6.1.3 Stream Temperature

There are 8,624 acres of Riparian Reserves in the Eddy Gulch LSR (see Maps A-6a and A-6b in Appendix A). Prior to the 1995 Klamath LRMP, timber harvest occurred in areas now designated as Riparian Reserves, and as a result, approximately 4 percent of Riparian Reserves are in plantation status and lack desired vegetation characteristics, including structural diversity, which provides adequate thermal regulation and supplies coarse wood to streams.

All of the 7th-field watersheds in the LSR have stream temperatures that are considered "properly functioning." Water temperatures are considered "properly functioning" in lower order streams when temperatures are 69ºF or less. In addition to previous data collected by the Klamath National Forest for all 7th-field streams, some streams were sampled in 2008: main stem reaches of Whites Gulch and Shadow Creek measured 59ºF in mid-August. Temperatures sampled in mid-July 2008 were as follows: Mathews Creek–62.5ºF, South Music–61ºF, Taylor Creek–55.5ºF, and Russian Creek–55.5ºF. During field reviews of the Assessment Area in mid-August 2008, water temperatures were measured in numerous seeps and springs that flowed into Whites Gulch, South Music, and Sixmile Creek, and temperatures ranged from 46.5ºF–57ºF. These small, low-flow perennial cold seeps and springs are common in the analysis area and collectively feed 7th-field drainages downstream, and are crucial for maintaining cool temperatures in summer and fall months. Cool water temperatures in tributaries in the LSR highlight the importance of these streams relative to providing cool water inflows to warmer habitat downstream of the LSR that are used by anadromous salmonids, including within the North Fork and South Fork Salmon River.

1.7 Desired Conditions

1.7.1 Sediment

Desired conditions include limiting disturbance and minimizing sediment delivery by reducing the potential for stand-replacing fire while maintaining ground cover and Riparian Reserve functions.

Disturbances

Roads are typically the biggest anthropogenic source of accelerated erosion, depending on their location and construction type. Management direction includes limiting the total extent of roads by watershed, having no net increase in road mileage in key watersheds, minimizing road prisms, applying appropriate road drainage, using care in the design of road–stream crossings, strictly limiting the number of crossings, avoiding lower slope or stream-parallel routes, and avoidance of unstable slopes.

Landslides. As described earlier, channel and valley morphology (steep, structurally controlled slopes within narrow valleys) in the Eddy Gulch LSR have the greatest influence on fish habitat, including channel gradients, wood storage, gravel availability / storage, and fine sediment distribution. The desired condition is that sediment inputs from streamside landslides and debris flows is within the range of natural variability and are not human-caused. These dominant natural landscape

processes drive existing conditions of fish habitat in the LSR, and thus, it is crucial that unstable areas are protected from activities that could destabilize them and trigger a landslide event.

Floods. Floods have been a dominant disturbance process that periodically resets instream habitat conditions. The desired condition for the Eddy Gulch LSR Project is to manage vegetation and soils on the landscape in a condition that provides resiliency should a flood event occur, including maintaining adequate soil cover and root stability on slopes and protecting watersheds from the effects of a severe wildfire.

Roads. The desired condition for road density is to have less than 2 miles of road per square mile of watershed.

Cumulative Watershed Effects Model

The desired conditions for watersheds with high CWE risk ratios are to continue to allow recovery from past disturbances, while protecting watersheds from the effects of future disturbances.

Flood Return Intervals

The desired condition is to maintain total ERA under the established threshold of concern for each 7th-field watershed.

1.7.1.1 Large Woody Debris

The desired condition is late-successional stand conditions in Riparian Reserves. As discussed earlier, the condition of Riparian Reserves is a primary influence on water quality and fisheries habitat. Desired conditions for Riparian Reserves include managing the Riparian Reserve system to attain an intact and connected network of protected stream buffers composed of vegetation at target potential natural community and functioning to provide adequate shade to streams, large wood recruitment, sediment filtering capacity, and habitat connectivity similar to those conditions that fish evolved under.

1.7.1.2 Stream Temperature

The desired condition for stream temperatures is to have temperatures at 57ºF or less, which closely characterizes existing conditions in 7th-field streams in the Eddy Gulch LSR.

1.7.1.3 Summary of Existing and Desired Conditions

From the standpoint of watershed function, part of Objective 2 is to protect municipal watersheds, and this involves managing soil and vegetation in a manner that allows natural recovery of historic regimes of watershed inputs and outputs. Specifically, this refers to sediment delivery regimes, flood return intervals, and the frequency and pattern of large wood input to streams, and the energy balance of streams (water temperature). The return of these historic regimes can be advanced through the protection of aquatic habitats and municipal watersheds from stand-replacing fire. Table 5 summarizes existing and desired conditions relative to the measurement indicators previously presented.

Table 5. Summary of existing and desired conditions relative to indicators.

Resource Attribute	Measurement Indicator	Desired Condition Target/Threshold	Existing Condition
Water Quality / Fisheries Habitat Quality	Sediment–CWE risk ratios (all components)	Risk ratios less than 1.0.	Watersheds at or near threshold: USLE—Eddy Gulch (1.05) and Shadow Cr (0.94). GEO—Upper No. Russian (0.87), Indian (0.87), Eddy Gulch (0.79), and Kanaka-Olsen (1.53) ERA—Indian (1.04). All other watersheds well below threshold.
Water Quality	Flood regime-CWE ERA risk ratios	Risk ratios less than 1.0.	Watersheds are at or near threshold: ERA—Indian (1.04). All other watersheds well below threshold.
Water Quality / Fisheries Habitat Quality	Stream temperature	57ºF or less for 7th-field tributaries to maintain optimal cold water inflows to main stems.	Mid-summer, mid-day temperatures 58ºF–59ºF.
Water Quality / Fisheries Habitat Quality	Stream shade	80% or site potential.	Stream temperature data indicates adequate shade across the analysis area; 85% average from survey of Crawford and Shadow creeks.
Fisheries Habitat Quality	LWD	More than 80 pieces of large wood (larger than 24 inches in diameter and longer than 50 feet) per mile AND current riparian vegetation condition near site potential for recruitment of LWD.	North Russian 10.8 pieces / mile, so Russian 3.2 pieces / mile, Whites Gulch 4.5 pieces/mile (data from the North Fork Watershed Analysis). Qualitative assessment from field reviews is that LWD is below quantitative desired condition standard, but that stream morphology reduces the capability for streams to store large wood; Riparian Reserve condition is at desired condition or trending towards desired condition relative to large wood recruitment.

1.8 Environmental Consequences

1.8.1 Alternative A: Effects of the No-action Alternative

The no-action alternative is described in Section 1.2 above.

Actions with Potential to Affect Sediment Indicator

Road construction. No new roads would be constructed under Alternative A.

Skid trails, landings, and cable corridors associated with thinning units. There are no thinning treatments associated with Alternative A. Fireline construction would be expected under the anticipated wildfire scenario. Exact locations and types of firelines would depend on location of fire and its behavior.

Mastication of fuels. No mastication would occur under Alternative A.

Prescribed underburning. No prescribed underburning would occur under Alternative A.

Water drafting. Water drafting would be a likely activity related to wildfire suppression. Water drafting under conditions of a wildfire may not occur with the same level of resource protection as would be expected under normal project conditions.

Wildfire and suppression actions. Loss of cover exposes soil to raindrop impact and subsequent erosion. This, in turn, can lead to loss of soil productivity and delayed recovery through vegetative regrowth. Where fire severity is high adjacent to streams, erosion can lead to sediment delivery to those streams. The direct effect, in this instance, would be to stream segments directly impacted by moderate to high-intensity fire. The magnitude of the direct effect is dependent on the total length of channel experiencing high-intensity fire. In general, the indirect effect of accelerated sediment delivery is of greater concern because sediment moves downstream to affect an ever-increasing amount of aquatic habitat.

The modeled wildfire under the no-action alternative is 7,200 acres in average extent. Eleven percent, or approximately 780 acres, is predicted to experience stand-replacing fire intensity. This would generally include 50–100 acres of Riparian Reserves. While much canopy would be retained, most soil cover in the form of litter and duff would be consumed.

Impervious surface can be created through soil disturbance and compaction and from the creation of hydrophobic soils. Under the no-action wildfire scenario, increases in impervious surface can result from the use of heavy equipment in fire suppression (disturbance/compaction) and high-intensity fire (hydrophobic soils). When sufficient impervious surface has been created within a watershed, a higher proportion of storm and snowmelt runoff is manifest as surface runoff. A smaller proportion infiltrates into the soil, taking slower paths to stream channels. This can result in higher peak flows for each unit of precipitation or snowmelt. When these conditions persist, it represents a shortening of flood return intervals. A fundamental shift in the frequency of channel-shaping flood events can produce an increased potential for channel scour. Where impervious surfaces are created in near-stream areas, these effects can be disproportionately higher.

The indicators related to sediment are comprised of the risk ratios produced by the Klamath National Forest's CWE model as described above in Section 1.5.5 Each of the three risk ratios assesses a particular type of watershed disturbance process. The ERA risk ratio looks at creation of impervious surface relative to a threshold based on watershed sensitivity. The USLE risk ratios look at sheet and rill erosion potential from soil disturbance. The GEO component indexes the potential for landslide-generated sediment. Each component assesses actions with the potential to generate sediment. As such, the desired condition for this indicator is for all risk ratios in all 7th-field watersheds to be below 1.0.

The CWE model requires spatially specific disturbance information as input. This information was supplied by output of the fire behavior model FLAMMAP. Fire and Fuels specialists on the ID team ran the model with three separate ignition points, each point representing a likely point of human-caused ignition. Each ignition produced wildfires of similar size and intensity but in different locations. For purposes of the CWE analysis, fire model output for the Shadow Creek Campground ignition point was used. The rationale for this selection includes these points:

- The Shadow Creek ignition produces the greatest concentration of burned acres within a single 7th-field watershed (Shadow Creek).
- Shadow Creek has a relatively large amount of past disturbance (existing roads and regeneration harvest units) when compared to other 7th-field watersheds in the analysis area.
- Shadow Creek is a municipal watershed.

The no-action alternative with the modeled wildfire just described was analyzed using the CWE model. Table 6 displays risk ratios produced by the CWE model for this alternative.

Table 6. CWE model results for the no-action alternative with modeled wildfire scenario.

7th-field Watershed	USLE		ERA		GEO	
	Pre-fire	Post-fire	Pre-fire	Post-fire	Pre-fire	Post-fire
Sixmile Creek	0.516	0.545	0.122	0.142	0.364	0.388
Gould-East Fork South Fork Salmon	0.347	1.383	0.164	0.645	0.454	0.838
Shadow Creek	0.934	2.854	0.181	1.002	0.408	1.067
Gooey-Ketchum	0.259	0.413	0.118	0.176	0.497	0.538
Crawford Creek	0.457	0.458	0.216	0.216	0.287	0.287
Whites Gulch	0.283	0.299	0.128	0.134	0.186	0.188

Major increases in the risk ratios for Shadow Creek and Gould-East Fork Salmon are evident. Especially high is the 2.85 USLE risk ratio for Shadow Creek, highlighting the potential of the wildfire to increase sediment yield. These results should be interpreted with caution. They are not a statement of the expected outcome of a specific action but an example of a reasonably possible outcome. Only watersheds affected by the modeled wildfire are shown in the table. Under the no-action alternative, all other 7th-field watersheds have risk ratios that reflect current conditions only.

Because the CWE model produced the dramatic increase in the USLE risk ratio, a second approach was employed to corroborate the CWE model's suggestion of a high potential to increase erosion and sedimentation. The WEPP soil erosion and sediment delivery model was used to estimate sediment delivery rates from a prototypical slope profile under natural vegetation and modeled wildfire. Model results suggest an approximately 50-fold increase in per-acre sediment yield in the first year following fire, declining to pre-fire conditions in 5–10 years. Using local climate data, the model also predicts a 90–100 percent chance of sediment delivery in the first year following the fire. These effects would be predicted to occur on the 7,200 acres that burn under the modeled wildfire scenario.

Taken together, the results of the WEPP and CWE analyses suggest that the potential severity of increased sedimentation from wildfire is high. The potential to adversely affect domestic use of water from municipal watersheds under such a wildfire scenario is reasonably likely. Such an increase in sediment yield has a reasonable likelihood of resulting in measurable increases in stored in-channel sediment, thus adversely affecting aquatic habitat. The magnitude of this potential effect is judged to be moderate to major (depending on the spatial pattern an actual fire would produce) with an expected duration of a decade or less.

Actions with Potential to Affect Flood Regime Change Indicator

Road construction. No new roads would be constructed under Alternative A.

Skid trails, landings, and cable corridors associated with thinning units. There are no thinning treatments associated with Alternative A. Fireline construction would be expected under the

anticipated wildfire scenario, but the exact locations and types of firelines would depend on location of fire and its behavior.

Mastication of fuels. No mastication would occur under Alternative A.

Prescribed underburning. No prescribed underburning would occur under Alternative A.

Water drafting. Water drafting would be a likely activity related to wildfire suppression. Water drafting does not affect the flood regime indicator.

Wildfire and its suppression. The measurement indicator that gauges the potential for altered flood regimes due to the creation of impervious surface is the ERA component of the CWE model. The desired condition is a risk ratio less than 1.0 in each 7th-field watershed in the analysis area. That would indicate that the total amount of impervious surface (ERA) from all past, current, and reasonably foreseeable activities is below the threshold of concern. The reader is again referred to Table 6 above for the results of the CWE model. The wildfire scenario causes an estimated increase in the ERA risk ratio for Shadow Creek that pushes up to the 1.0 inference point. This is not an actual effect but serves to point out that a fire of this magnitude and spatial pattern has the potential to create adverse hydrologic conditions. The best way to categorize the situation relative to flood regime change in Shadow Creek is "at risk." A risk ratio substantially over 1.0 would be necessary to arrive at a higher estimation of the magnitude of the effect. The Klamath CWE model uses fairly conservative ERA threshold of concern values so some factor of safety is built into these risk ratio estimates.

Actions with Potential to Affect Stream Temperature Indicator

Road construction. No new roads would be constructed under Alternative A.

Skid trails, landings, and cable corridors associated with thinning units. There is no timber harvest associated with Alternative A. Fireline construction would be expected under the anticipated wildfire scenario. Exact locations and types of firelines would depend on location of fire and its behavior.

Mastication of fuels. No mastication would occur under Alternative A.

Prescribed underburning. No prescribed underburning would occur under Alternative A.

Water drafting. Water drafting would be a likely activity related to wildfire suppression. Water drafting under conditions of a wildfire may not occur with the same level of resource protection as would be expected under normal project conditions and could therefore affect stream temperatures if flows were substantially reduced (this will not occur due to implementation of NMFS' Water Drafting Guidelines).

Wildfire and its suppression. Stream temperature is likely to be adversely affected due to the 50–100 acres of Riparian Reserve predicted to be consumed by high-intensity wildfire. This effect is dependent on the actual extent and location of stand-replacing fire in Riparian Reserves. For example, many small burned-out patches dispersed across the landscape would have less impact on these

indicators than a few large contiguous blocks in a single watershed. Wildfire modeling does not provide conclusive evidence that stream temperature would be significantly affected.

Actions with Potential to Affect Large Woody Debris Recruitment Indicator

Road construction. No new roads would be constructed under Alternative A.

Skid trails, landings, and cable corridors associated with thinning units. There is no timber harvest associated with Alternative A. Fireline construction would be expected under the anticipated wildfire scenario. Exact locations and types of firelines would depend on location of fire and its behavior.

Mastication of fuels. No mastication would occur under Alternative A.

Prescribed underburning. No prescribed underburning would occur under Alternative A.

Water drafting. Water drafting would be a likely activity related to wildfire suppression. Water drafting does not affect the LWD indicator.

Wildfire and its suppression. A wildfire could reduce long-term LWD recruitment at the 7th-field scale if Riparian Reserves were burned. Modeled wildfires average 6–7 percent of Riparian Reserves consumed by high-intensity fire within the fire perimeter. This would add cumulatively to existing low levels of LWD in 7th-field streams and in habitat downstream that receives large wood from the analysis area. Low levels of large wood in the subject 7th-field streams are partly due to the physical attributes of streams, which facilitate wood transport rather than storage. However, a wildfire would add cumulatively to existing low levels of LWD in the analysis area and would decrease long-term recruitment to downstream alluvial reaches and pools, where wood plays a vital role in habitat complexity for spawning and rearing salmonids.

Hazard tree removal. Hazard trees may be removed along roads and could affect LWD in Riparian Reserves. However, the Klamath National Forest Hazard Tree Guidelines (USFS 2005) will be implemented and trees felled within Riparian Reserves would be left on site. Therefore, LWD levels in Riparian Reserves will not be affected by hazard tree removal.

Actions with Potential to Affect the Road Density Indicator

Road construction. No new roads would be constructed under Alternative A.

Skid trails, landings, and cable corridors associated with thinning units. There is no timber harvest associated with Alternative A. Fireline construction would be expected under the anticipated wildfire scenario. Exact locations and types of firelines would depend on location of fire and its behavior.

Mastication of fuels. No mastication would occur under Alternative A.

Prescribed underburning. No prescribed underburning would occur under Alternative A.

Water drafting. Water drafting would be a likely activity related to wildfire suppression. Water drafting does not affect the Road Density indicator.

Wildfire and its suppression. These actions would not change road density under Alternative A.

Conclusion: Summary of Potential Impacts on Aquatic Resources

CWE model risk ratios serve as the metric for sediment-related indicators. Table 7, which is presented under the discussion of Alternative B, contains risk ratios for the current condition plus foreseeable future actions, along with those for the action alternatives. The following discussion makes reference to these risk ratios. In the interest of avoiding redundancy, Table 7 is not repeated in this discussion of Alternative A. Table 6 (presented previously) contains risk ratios relevant only to the modeled wildfire scenario, and thus, is only pertinent to Alternative A.

Direct and Indirect Impacts on Fisheries Habitat (Beneficial Use "COLD")

Based on the modeled wildfire and the modest amount of Riparian Reserves that would be burned, it is unlikely that a wildfire would directly kill fish. The habitat effects of a wildfire would likely constitute an indirect effect on fish since they would occur later in time. Although a surface fire would consume litter, small woody debris, shrubs, and some large trees, Riparian Reserves have higher fuel moistures, resulting in low potential for direct effects on fish; that is, there is low potential for a severe fire to burn over streams and directly kill fish. Indirect effects on fisheries are evaluated in the bulleted items that follow.

- Failing to implement fuels reduction treatments would increase the risk of stand-replacing wildfire and the accompanying loss of protective soil cover, leading to accelerated erosion and sedimentation. High USLE and ERA risk ratios resulting from CWE analysis of the modeled wildfire indicate that potential adverse sediment effects on fish habitat would be high under the no-action Supporting this conclusion is the WEPP model output showing a 50-fold increase in first year erosion rates with a virtual certainty that a portion of this accelerated erosion will reach streams.

- The magnitude of this impact is judged to be moderate to major depending on the dispersion of high-intensity fire across 7th-field watersheds. The duration of adverse effects is likely to be on the order of 5 to 10 years.

- Failing to implement fuels reduction treatments would increase the risk of stand-replacing wildfire and the accompanying increase of impervious ground surface, leading to an increase in overland surface runoff. Based on conditions predicted by the modeled wildfire scenarios, sediment effects related to altered runoff regime are likely to be negligible to minor. This is due to the modest amounts of Riparian Reserves consumed by high-intensity fire and the high probability that suppression-related disturbance would likely be concentrated along ridgetops and existing roads. Additionally, the loam-clay loam soils characteristic of the analysis area are not the kind of noncohesive soils most prone to developing hydrophobic conditions following fire. The duration of effects is likely to be short term as regrowth of vegetation and other processes break up impervious surfaces and areas of hydrophobic soils. The intensity of this effect is negligible to minor.

- Failing to implement fuels reduction treatments would increase the risk of stand-replacing wildfire and the accompanying loss of riparian shade canopy, leading to stream temperature increases. Where stand-replacing fire intensity occurs in streamside zones, shade canopy is lost, exposing streams to increased amounts of solar radiation. To

experience a measurable increase in temperature, relatively large contiguous segments of stream must experience significant reduction in shade canopy. Spatial patterns of high-intensity fire produced by the wildfire model do not exhibit this pattern. The model suggests that 6–7 percent of Riparian Reserves would experience stand-replacing fire in a patchy, noncontiguous spatial pattern. Most 7th-field tributaries are narrow, steep, and north-south trending, all of which suggests lower vulnerability to temperature increases.

- Adverse effects on stream temperature under the no-action alternative are expected to be negligible to minor and of short duration because the regrowth of riparian shrubs is usually quite rapid following the removal of overstory, and physical conditions as described above may attenuate loss of stream shade. No significant effects are expected due to this process.

- Failing to implement fuels reduction treatments would increase the risk of stand-replacing wildfire and the accompanying loss of snags and large trees near streams. The no-action alternative may cause indirect effects on fish and their habitat because fuel loadings are high in the LSR, and groups of trees could be killed in Riparian Reserves if a large wildfire were to occur. If overstory vegetation were damaged or lost, future large wood recruitment would be reduced. Post-fire (short- to mid-term) recruitment may increase due to the amount of dead trees. However, future long-term large wood recruitment in Riparian Reserves would likely be impacted (decreased).

  Indirect adverse effects on LWD recruitment are judged to be minor due to the relatively small area of Riparian Reserves predicted to be impacted by high-intensity fire.

Cumulative Effects on Fisheries Habitat (Beneficial Use "COLD")

The no-action alternative would not add project-related incremental effects to the effects of past, present/ongoing, or future projects because no management activities are proposed. However, were a wildfire to occur that is similar to the modeled wildfire, cumulative adverse effects on fish habitat are likely. Aquatic habitat is recovering from past disturbances, and fish populations are at low levels. Past surveys indicate that LWD is present in less than desired levels. Thus, a severe wildfire, in combination with past, present / ongoing, and future actions, could result in cumulative effects on fish associated with increases in sediment supply, localized increases in water temperature, and reduced long-term LWD recruitment. The magnitude of effects is expected to be minor to moderate (sediment impacts could be major within one or two 7th-field watersheds), depending on the spatial pattern of high-intensity fire. Temperature and sediment effects would be expected to recover within 5 to 10 years, while effects on large wood recruitment would persist for multiple decades.

Foreseeable future actions are listed in Section 3.1.4 of the Eddy Gulch LSR Project EIS. Two of the listed actions (North Fork Roads Stormproofing Project and construction of a fuelbreak system west of Black Bear Ranch) were also included in the input to the CWE model and are reflected in the model output (Appendix D). In all 7th-field watersheds affected by future projects, the net effect of those projects is a small but consistent decrease in risk ratios. The road project represents a major long-term improvement to watershed conditions in the affected drainages. The details of the fuel break project are not yet fully developed. Assuming it involves only underburning and mastication along ridgetops with no road development, it is highly unlikely to have detectable adverse effects and will provide improved wildfire suppression and protection to the Black Bear and Callahan municipal watersheds.

Municipal/Domestic Uses of Water (Beneficial Use "MUN")

Direct and Indirect Effects

Direct effects to municipal / domestic uses of water are unlikely. Damage to impoundments or delivery infrastructure or introduction of pollutants at points of diversion are the most likely processes fitting the definition of "direct effect." Under the no-action alternative, inadvertent actions related to wildfire suppression would be the most likely mechanism producing direct adverse effects on municipal / domestic use. These are not foreseeable consequences and are dismissed from further analysis or discussion. Indirect effects on municipal / domestic use are evaluated in the bulleted items that follow.

- Failing to implement fuels reduction treatments would increase the risk of stand-replacing wildfire and the accompanying loss of protective soil cover, leading to accelerated sedimentation and high turbidity during major runoff events. Accelerated erosion and sedimentation can result in sediment deposition that damages diversion structures or renders them inoperative. High turbidity in water indicates the presence of particulates that can serve as substrates (and nutrients) for harmful microorganisms. CWE and WEPP model results suggest that a likely wildfire could be expected to have significant adverse effects on existing or potential municipal / domestic use of water, especially when stand-replacing fire intensity is concentrated within a 7th-field watershed.

- The magnitude of this effect is judged to be moderate, mostly because of the uncertainty associated with the location and spatial distribution of wildfire effects.

- Failing to implement fuels reduction treatments would increase the risk of stand-replacing wildfire and the accompanying increase in impervious surface, leading to alteration of channel-shaping flood regime. Channel and bank scour that could potentially result from this process can increase sediment loads and damage water diversion infrastructure in ways similar to those already discussed.

- The magnitude of this effect is judged to be negligible. This determination is based on the moderate increase in the Shadow Creek ERA risk ratio (Table 6) under the modeled wildfire scenario and the observation that most 7th-field channels are well-armored and highly confined transport channels with low potential for rapid incision or lateral migration.

Cumulative Effects on Municipal / Domestic Uses of Water (Beneficial Use "MUN")

No evidence was found to indicate that existing sediment or turbidity levels cause impairment to municipal/domestic uses of water. Because the CWE model input includes information from past and foreseeable future projects, its output offers the best quantitative assessment of potential cumulative effects to municipal/domestic use in the form of accelerated sedimentation. Listed municipal watersheds include Eddy Gulch, Black Bear Creek, Shadow Creek, Callahan Gulch, Counts Gulch, Crawford Creek, and Music Creek. Of these, Eddy Gulch and Shadow Creek are the only drainages with CWE risk ratios that could be described as "at risk." The CWE model values shown in Table 7 include the values for the current condition (2008), including past actions. The Kanaka-Olsen and Indian Creek watersheds are over the threshold of concern, but the risk ratios are decreasing and would fall below the threshold of concern by the time the project is fully implemented in 2014. The

same risk ratio for Shadow Creek is 0.93. No other risk ratios for municipal watersheds are in the "at risk" or higher range.

It is reasonable to conclude that the effects of wildfire in these two drainages would be superimposed on an existing level of disturbance that would make it easy to exceed thresholds of concern. Table 6 supports this conclusion by showing a USLE risk ratio change from 0.93 to 2.85 for Shadow Creek based solely on the effects of the modeled wildfire. Based on this, it is reasonable to conclude that the potential adverse effects of wildfire on municipal watersheds is so great that the existing condition of the affected watershed may not matter, being wholly overwhelmed by fire effects.

1.8.2 Alternative B: Effects of the Proposed Action

The primary concerns related to Aquatic Resources center on (1) the effects of temporary road construction and its potential for sediment delivery to streams; (2) the potential adverse effects of all project activities on municipal / domestic use of water; (3) the potential effects of modifying vegetation in Riparian Reserves to the detriment of sediment regime, stream temperature, and LWD recruitment; and (4) the potential adverse effects on fish and water quality from water drafting.

Both action alternatives propose thinning, fuels reduction treatments, and underburning, and both alternatives are similar in scope, scale, and location. The difference between the action alternatives is that Alternative C does not propose construction of 1.03 miles of new temporary roads, 822 fewer acres would be underburned, and handlines would be constructed around some burn units. Thinning in M Units would be reduced by 99 acres, from 931 acres in Alternative B to 832 acres in Alternative C. The magnitude of differences between the two action alternatives relative to potential effects on fish and their habitat are very small because mechanical units and proposed temporary roads are not within Riparian Reserves and are located on or near ridgetops. The differences between alternatives with regard to underburn acreage and handline construction would not result in any differences in effects on fish or their habitat. The proposed temporary roads would not cross any streams or other Riparian Reserves and are dispersed in a number of short segments across several watershed areas. The temporary roads would be closed, ripped, and re-contoured after use.

Design features applicable to both action alternatives include BMPs, Wet Weather Operating Standards (WWOS) (USFS 2002a), forestwide soil cover standards, as well as Klamath LRMP Standards and Guidelines. Application of these measures would minimize the effects of each action alternative on aquatic resources considered herein.

The following discussion of Alternative B includes multiple references to risk ratios produced by the Klamath National Forest's CWE model. Table 7 lists results of CWE analysis for watersheds in the analysis area under Alternatives B. The risk ratios reported under the column heading "2009" represent existing conditions plus foreseeable actions as listed in Section 3.1.4 of the EIS. The values reported for 2014 represent conditions at a point in time when all mechanical treatments (thinning units and FRZs) will be complete. The values reported for 2021 represent the point in time when all treatments have been implemented. A supplemental analysis of the effects of the 2008 and 2009 wildfires in the Salmon River sub-basin was done by Klamath National Forest hydrologist Gregg Bousfield (Eddy Gulch CWE addendum–September 23, 2009), and the conclusion is that the fires did not occur in any 7th-field watersheds in the affected environment and that no CWE values were

Table 7. CWE model results for Alternative B combined with the North Fork Roads Stormproofing Project.

	USLE				ERA				GEO			
	Current (2008)	Current Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021	Current (2008)	Current/ Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021	Current (2008)	Current Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021
7th-field Watersheds												
Black Bear Creek	0.39	0.39	0.50	0.39	0.32	0.32	0.32	0.18	0.44	0.44	0.42	0.39
Cody-Jennings Creek	0.41	0.41	0.41	0.41	0.24	0.24	0.20	0.16	0.49	0.49	0.47	0.43
Crawford Creek	0.46	0.46	0.47	0.46	0.22	0.22	0.29	0.20	0.29	0.29	0.28	0.27
Eddy Gulch	1.05	0.90	0.91	0.90	0.39	0.32	0.35	0.33	0.79	0.62	0.61	0.60
Gooey-Ketchum Creek	0.26	0.26	0.26	0.26	0.12	0.12	0.12	0.11	0.50	0.50	0.50	0.50
Gould-East Fork South Fork Salmon River	0.35	0.35	0.35	0.40	0.16	0.16	0.17	0.21	0.45	0.45	0.45	0.45
Indian Creek	0.53	0.53	0.53	0.53	1.04	1.04	0.59	0.24	0.87	0.87	0.78	0.66
Kanaka-Olsen Creek	0.19	0.15	0.15	0.15	0.30	0.27	0.17	0.10	1.53	1.43	1.18	0.90
Lower North Russian Creek	0.24	0.21	0.22	0.21	0.17	0.15	0.16	0.15	0.47	0.41	0.41	0.41
Lower South Russian Creek	0.40	0.30	0.31	0.30	0.54	0.42	0.40	0.31	0.55	0.36	0.35	0.34
Matthews Creek	0.42	0.42	0.43	0.42	0.15	0.15	0.16	0.15	0.47	0.47	0.46	0.46
Robinson-Rattlesnake Creek	0.24	0.21	0.21	0.21	0.17	0.16	0.13	0.13	0.34	0.32	0.31	0.31
Shadow Creek	0.94	0.93	0.96	0.97	0.18	0.18	0.29	0.25	0.41	0.41	0.41	0.41
Sixmile Creek	0.52	0.52	0.52	0.52	0.12	0.12	0.12	0.13	0.36	0.36	0.36	0.36
Tanner-Jessups Creek	0.47	0.34	0.34	0.34	0.51	0.46	0.37	0.32	0.61	0.41	0.39	0.38
Taylor Creek	0.26	0.23	0.23	0.23	0.16	0.14	0.14	0.13	0.20	0.15	0.15	0.15
Timber-French Creek	0.24	0.24	0.24	0.24	0.14	0.14	0.12	0.10	0.31	0.31	0.31	0.30
Upper North Russian Creek	0.35	0.27	0.30	0.27	0.32	0.26	0.37	0.23	0.87	0.60	0.59	0.58
Whites Gulch	0.53	0.28	0.29	0.28	0.21	0.13	0.14	0.12	0.35	0.19	0.17	0.17

Table 7. CWE model results for Alternative B combined with the North Fork Roads Stormproofing Project (continued).

	USLE				ERA				GEO			
	Current (2008)	Current Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021	Current (2008)	Current/ Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021	Current (2008)	Current Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021
6th-field Watersheds												
Cecilville-Crawford Creek	0.37	0.37	0.35	0.34	0.20	0.20	0.20	0.15	0.36	0.36	0.35	0.33
Main East Fork South Fork Salmon River–	0.38	0.38	0.38	0.39	0.13	0.13	0.16	0.15	0.29	0.29	0.29	0.29
North Russian Creek	0.28	0.24	0.25	0.24	0.21	0.18	0.21	0.16	0.46	0.35	0.35	0.34
Plummer-Black Bear Creek	0.23	0.23	0.26	0.24	0.25	0.25	0.21	0.13	0.41	0.41	0.38	0.35
South Russian Creek	0.21	0.15	0.16	0.15	0.20	0.16	0.14	0.10	0.27	0.16	0.15	0.14
Whites-Jackass	0.55	0.39	0.39	0.39	0.26	0.21	0.19	0.18	0.49	0.35	0.34	0.33
5th-field Watersheds												
North Fork Salmon River	0.19	0.15	0.13	0.13	0.23	0.20	0.16	0.11	0.55	0.48	0.41	0.34
South Fork Salmon River	0.29	0.29	0.28	0.28	0.26	0.26	0.23	0.17	0.38	0.38	0.36	0.33

pushed over threshold. Therefore, there will be no significant change in the Proposed Action's direct, indirect, or cumulative effects on water quality and aquatic resources as analyzed in the draft EIS: The wildfires did not cause any of the 7th- or 5th-field watersheds to significantly change model values, nor did these wildfires push model values to go over thresholds when combined with the Proposed Action.

Actions with Potential to Affect Sediment Indicators

Road construction. Seven segments (totaling 1.03 miles) would be constructed as new temporary roads. The longest new temporary road segment is 1,577 feet in length, and all temporary roads are on ridgetops or near-ridgetop locations. None are near Riparian Reserves, none require any stream crossing structures, none traverse unstable slopes, and none are proposed on granitic or similarly noncohesive soils. All of the temporary roads would be closed using normal erosion control measures (ripped and mulched, as needed).

Four segments (totaling 0.98 mile) of former logging access routes currently closed to vehicle use, would be re-opened under Alternative B. The longest of these is a 2,154-foot segment of old fireline for accessing M Units 8 and 43. The former logging access routes are on ridgetops or near-ridgetop locations and none cross streams or other Riparian Reserves. These routes would be water-barred and closed immediately after thinning is completed.

The temporary roads and former logging access routes are associated with thinning units (the M Units), and would be used primarily to provide yarder access to steeper ground that can only be thinned by cable yarding. These roads/routes, taken together, are distributed across three 7th-field watersheds as follows: Black Bear (0.25 mile), Crawford Creek (0.43 mile), and Shadow Creek (1.05 miles).

Construction of new temporary roads has the potential to increase sediment delivery to streams. A substantial body of literature suggests that roads can be significant producers of sediment and can alter hydrologic patterns on a hillslope (Trombulak and Frissell 2000). Road segments that present the greatest risk for sediment delivery have a number of common traits, including (1) alignments parallel to stream, (2) numerous stream crossings, (3) alignments that traverse unstable slopes, (4) constructed in noncohesive soils, and (5) steep side slopes creating large cut and fill slopes. None of the temporary spurs proposed under Alternative B exhibit these characteristics.

The disturbance associated with temporary roads was incorporated into the input for the CWE model and is reflected in the resulting risk ratios that serve as the metrics for the sediment indicator. Model results do not segregate road impacts from other disturbances. However, when taken together, all project-related disturbances associated with Alternative B fail to result in any 7th-field watershed producing risk ratios over threshold. This is best assessed by comparing "2009" risk ratios with those for "2014" when all roads would have been constructed and the thinning units they access would have been harvested. Increases are, without exception, minimal—measurable mostly at the second decimal. Some risk ratios actually decline due to the North Fork Roads Stormproofing Project and natural recovery over time.

Skid trails, landings, and cable corridors associated with thinning units. Approximately 73 existing landings (wide spots in roads or forest openings) are proposed for the thinning units. All of these are associated with tractor units. Cable yarding would use the road prism for "hot decking" of

logs such that no additional landings are proposed for cable units. (Basically, hot decking occurs when the running surface of the road is not wide enough for both the cable yarder and the logs. The logs have to be moved out of the way so another load can be brought to the road, where trucks haul them away—this eliminates the need for landing construction because the road prism itself serves as the landing.) Total clearing for landings over the entire Assessment Area is estimated to cover 18 acres (the landings are shown on Maps A-1 and A-2 in this report). None of the landings are in Riparian Reserves or other sensitive lands. All landings will receive post-project erosion control as described in the Klamath LRMP.

Cable corridors would be located approximately 150 feet apart and oriented parallel to each other when possible. Several exceptions to the parallel alignment of corridors exist. Logs will have one-end suspension with the other end dragging on the slope. Heavy yarding volume in any one corridor can cause excessive soil disturbance. This is not expected to occur because harvest volumes per acre are generally light and because slash on the ground helps cushion and protect the soil from excessive disturbance. Resource protection measures (included in Alternative B) require erosion control measures in cable corridors where soil disturbance exceeds ground-cover retention guidelines.

Mastication of fuels. Mastication of understory fuels is proposed in FRZs where slopes are less than 45 percent. This usually involves the ridgeline itself and a short distance downslope on either side. Masticators are small, low ground pressure, tracked machines that minimize soil disturbance and compaction compared to much larger equipment such as log skidders. Mastication produces abundant ground cover in the form of small fragments of woody vegetation processed by the equipment. Effects on soil erosion and sedimentation processes from mastication would be minimal and are significantly outweighed by the benefits of breaking up fuel continuity and creating ample ground cover in the process.

Prescribed underburning. Prescribed fire is proposed on several thousand acres in the LSR. The prescribed burns will target consumption of understory fuels while retaining adequate soil and canopy cover. Due to the uneven distribution of fuels and fuel moistures, exact adherence to cover guidelines cannot be guaranteed on every acre subject to treatment. Limited but unforeseen flare-ups in fuel accumulations are likely to occur in some areas. The greatest potential for sediment generation would be related to flare-ups within Riparian Reserves. Adverse effects would be associated with the generation and subsequent movement of sediment in the critically important near-stream zone. Within this zone, adequate soil cover helps maintain an effective filter to buffer streams from sediment generated from upper slope positions. Loss of cover reduces the filtering function and can expose soil to erosive forces. Sediment generated within the near-stream zone has a much higher chance of reaching the stream due to the shorter flow path. Such events are expected to be few in number and limited in size by the fact that burn plans will consider retention of cover in these areas in conformance with Klamath LRMP guidance (ACS, Riparian Reserve Standards and Guidelines, BMPs, and related resource protection measures).

Underburning will be consistent with guidelines in the *Biological Assessment and Evaluation for Pre-Commercial Thin and Release Actions and Fuel Reduction Actions on the Klamath National Forest* (USFS 2001), which limits burn prescriptions and design within Riparian Reserves, and establishes a cap on the amount of acreage that can be burned in a given year to prevent adverse effects to aquatic habitat and fish.

Water drafting. The only action that would occur in stream channels that would have the potential for direct effects on fish or their habitat is water drafting. Nineteen proposed water drafting sites have been identified (Maps A-1 and A-2 in Appendix A of this report). Nine sites are within (the following) fish-bearing streams: Lower North Russian Creek (3), Upper North Russian Creek, Robinson-Rattlesnake, Crawford Creek, Shadow Creek, Whites Gulch, and Cody-Jennings. Drafting sites have existing access but may be rocked to reduce surface erosion of dirt roads. Water drafting will be done according to the NMFS Water Drafting Specifications (NMFS 2001b), which limits the amount and rate at which water can be withdrawn during pumping and requires pumps to be screened. By following these specifications and considering the instincts of fish to flee when a water truck approaches, potential effects of water drafting in fish-bearing reaches would be negligible.

Wildfire and suppression actions. The risk of stand-replacing wildfire and its associated increase in erosion and sedimentation would be reduced by project activities. Thinning and FRZ treatments on ridgetops, along with roadside fuel reductions, provide more and better options for wildfire control tactics.

Actions with Potential to Affect Flood Regime Change Indicator

Road construction. Roads contribute to the total amount of impervious ground surface. Too many miles of road, especially roads located in near-stream areas, can result in large increases in surface runoff which can lead to larger volumes of stormflow reaching stream channels in a shorter period of time. Where roads are more distant from channels, surface runoff generated from the road prism has much more opportunity to infiltrate at points along its flow path.

The ERA risk ratios in Table 7 above show no increases of concern. This includes the effect of proposed temporary roads as well as all other project activities.

Skid trails, landings, and cable corridors associated with thinning units. Under Alternative B, the use of existing landings and skid trails will be maximized. This renews disturbance on those sites but minimizes the creation of new impervious surfaces elsewhere. All skid trails and landings will receive full erosion control implementation upon project completion.

Cable corridors do not produce important amounts of impervious surface and thus present no risk relative to flood regime change.

Skid trails and landings are included in the CWE model input and reflected in its output. As previously stated, nothing in Alternative B would result in a significant increase in any risk ratio in any watershed.

Mastication of fuels. No impervious surfaces will be created as a result of mastication. This is because the masticator is a small, low-ground-pressure machine, and the process of mastication increases ground cover and reduces the formation of erosion pavements.

Prescribed underburning. No impervious surfaces will be created as a result of prescribed underburning. Some handline construction may occur but is unlikely to produce any measurable adverse effects.

Water drafting. Water drafting does not create new impervious surface and does not contribute to flood regime change. Existing access roads will be used.

Wildfire and its suppression. The reduced risk of wildfire would lower the potential to create impervious surfaces as a result of wildfire and suppression activities. The RS treatments along emergency access routes would provide greater opportunity for carrying out control strategies from existing roads, and fuelbreaks (the FRZs) would result in less need for fireline construction.

Actions with Potential to Affect Stream Temperature Indicator

Road construction. No roads are proposed in any Riparian Reserve. Proposed road construction or reconstruction would not affect stream temperature because no riparian or near-stream vegetation will be affected.

Skid trails, landings, and cable corridors associated with thinning units. No skid trails or landings are proposed in Riparian Reserves. No near-stream vegetation will be affected by skid trails or landings. Because of this, no impact on stream temperature would result from the use of skid trails and landings.

Some thinning units (M Units 15, 19, 21, 24, 40, 51, 61, and 76) have small portions of Riparian Reserves within or near their boundaries. In each instance, streamside management zones have been prescribed to ensure that canopy and ground cover guidelines are met. The small amount of area involved, along with Streamside Management Zone (SMZ) protections, ensures that no stream temperature impacts would result.

Mastication of fuels. No mastication is anticipated in Riparian Reserves. In the rare event that mastication does occur in a Riparian Reserve, operation will be limited in order to meet ground cover and canopy cover retention guidelines. Effects on near-stream vegetation will be non-existent to extremely limited.

Prescribed underburning. The greatest potential for adverse stream temperature effects would be related to flare-ups within Riparian Reserves. Flare-ups could remove canopy and create openings adjacent to streams. The magnitude of this potential effect is dependent on fuel continuity and fuel moisture within Riparian Reserves at the time of ignition. Burn prescriptions can and will exert control over this by specifying burn patterns, points of ignition, fuel moistures, and other factors that will limit it.

Such events are expected to be few in number and limited in size by the fact that burn plans will consider retention of cover in these areas in conformance with Klamath LRMP guidance (ACS, Riparian Reserve Standards and Guidelines, BMPs, and related resource protection measures). The magnitude of this effect is expected to be very similar between Alternatives B and C because only 99 acres less cable thinning and 822 acres less underburning would occur under Alternative C.

Underburning will be implemented consistent with guidelines in the *Biological Assessment and Evaluation for Pre-Commercial Thin and Release Actions and Fuel Reduction Actions on the Klamath National Forest* (USFS 2001) which limits burn prescriptions and design within Riparian Reserves, and establishes a cap on the amount of acreage that can be burned in a given year, to prevent adverse effects on aquatic habitat and fish.

Water drafting. Water drafting is unlikely to affect stream temperature because it does not result in modification of near-stream vegetation and NMFS (2001b) water drafting guidelines will be implemented to protect instream flows.

Wildfire and its suppression. The reduced risk of wildfire would lower the potential for stand-replacing fire in Riparian Reserves.

Actions with Potential to Affect Large Woody Debris Recruitment Indicator

Road construction. No roads are proposed in any Riparian Reserve. Proposed road construction or reconstruction is unlikely to affect LWD recruitment because no riparian or near-stream vegetation will be affected.

Skid trails, landings, and cable corridors associated with thinning units. No skid trails or landings are located in Riparian Reserves, and no near-stream vegetation would be affected by skid trails or landings; because of this, there would be no adverse effects on LWD recruitment.

Some thinning units (M Units 15, 19, 21, 24, 40, 51, 61, and 76) have small portions of Riparian Reserves within or near their boundaries. In each instance, streamside management zones or Riparian Reserves have been prescribed to ensure that canopy and ground cover guidelines are met. There would be no effect on LWD or future LWD recruitment due to the small amount of acreage of Riparian Reserves near or within units, the fact that M Unit treatments will be outside of Riparian Reserves, the fact that Riparian Reserves are not on perennial streams, and because resource protection measures will be employed.

Mastication of fuels. No mastication is anticipated within Riparian Reserves. In the rare event that mastication does occur in a Riparian Reserve, operations will be limited to meet ground cover and canopy cover retention guidelines. Effects on near-stream vegetation will be non-existent to extremely limited.

Prescribed underburning. The greatest potential for adverse effects on LWD recruitment would be related to flare-ups within Riparian Reserves. Flare-ups could remove canopy and create pockets of standing dead trees adjacent to streams. Initially, there would likely be an increase in LWD as fire-killed trees decay and fall. This would be followed by a long period of no recruitment from these areas. The magnitude of this potential effect is dependent on fuel continuity and fuel moisture within Riparian Reserves at the time of ignition. Burn prescriptions can and will exert control over this by specifying burn patterns, points of ignition, fuel moistures, and other factors that will limit the level of effects. Such events are expected to be few in number and limited in size by the fact that burn plans will consider retention of cover in these areas in conformance with Klamath LRMP guidance (ACS, Riparian Reserve Standards and Guidelines, BMPs, and related resource protection measures). The magnitude of this effect is expected to be very similar between Alternatives B and C because only 99 acres less cable thinning and 822 acres less underburning would occur under Alternative C.

Underburning will be implemented consistent with guidelines in the *Biological Assessment and Evaluation for Pre-Commercial Thin and Release Actions and Fuel Reduction Actions on the Klamath National Forest* (USFS 2001), which limits burn prescriptions and design within Riparian Reserves, and establishes a cap on the amount of acreage that can be burned in a given year to prevent adverse effects to aquatic habitat and fish.

Water drafting. Water drafting will have no effect on LWD or LWD recruitment because there would be no modification of near-stream vegetation, and only existing access roads will be used.

Wildfire and its suppression. The reduced risk of wildfire would lower the potential for stand-replacing fire in Riparian Reserves and loss of LWD.

Hazard tree removal. Hazard trees may be removed along roads and could affect LWD in Riparian Reserves. However, the Klamath National Forest Hazard Tree Guidelines (USFS 2005) will be implemented, and trees felled within Riparian Reserves would be left on site; therefore, LWD levels in Riparian Reserves would not be affected by hazard tree removal.

Actions with Potential to Affect the Road Density Indicator

Road construction. Alternative B proposes 1.03 miles of new temporary road construction and 0.98 mile of re-opening former logging access routes. All 2.01 miles of temporary roads/routes occur in three 7th-field watersheds: Black Bear (0.25 mile), Crawford Creek (0.43 mile), and Shadow Creek (1.05 miles). These are the only drainages in which road density would be affected. Shown below are the changes in road density that would result from implementation of Alternative B.

	Pre-project (mi/mi^2)	Post-project (mi/mi^2)
Black Bear Creek	2.67	2.69
Crawford Creek	3.09	3.12
Shadow Creek	2.73	2.85

Although all reported road densities in these drainages exceed the desired threshold of 2.0 mi/mi^2, the magnitude of the increase is very small. Closing these roads immediately after use will hasten vegetative regrowth such that these increases to the threshold will be recovered to pre-project levels within a decade. There will be no changes to road density in Riparian Reserves because no construction of temporary roads or re-opening of former logging access routes would occur in those areas.

Skid trails, landings, and cable corridors associated with thinning units. These actions would have no effect on road density.

Mastication of fuels. This action would not affect road density.

Prescribed underburning. This action would not affect road density.

Water drafting. This action would not affect road density because only existing access roads will be used.

Wildfire and its suppression. These actions would not affect road density.

Direct and Indirect Impacts on Fisheries Habitat under Alternative B (Beneficial Use "COLD")

Water drafting from streams has the potential to adversely affect fish by temporarily dewatering channels and entraining young fish into pump intakes. Existing water drafting sites will be used. The incorporation of NMFS (2001b) Water Drafting Specifications as resource

protection measures will prevent these potential impacts. Erosion control and proper drainage will prevent sedimentation and turbidity increases.

Construction of new temporary roads and re-opening of former logging access routes have the potential to increase sedimentation in streams and degrade fish habitat. The proposed 1.03 miles of temporary road construction and re-opening of 0.98 mile of former logging access routes are minor in extent, totaling only 2.01 miles for the entire project. Their locations are well away from streams or unstable slopes. The extent of proposed road construction produced a minute increase in CWE risk ratios and road density values. Closure following thinning will hasten recovery of road sites through erosion control and vegetative regrowth. The adverse effects of road construction would be negligible to minor, and the duration of the negligible or minor effects would not exceed one decade.

Mechanical treatments, mastication, and use of skid trails and landings could potentially increase the amount of soil disturbance, erosion, and sediment delivery to streams. Most mechanical units are on ridgetops or upper slope locations, with minimal overlap with seasonal (nonperennial) stream Riparian Reserves. Where those overlaps occur, SMZs and other resource protection measures (including quantitative ground cover requirements) are in place to ensure that near-stream areas do not become sediment sources and that their sediment filtering capacity is maintained. Tractor yarding is limited to slopes below 35 percent. All mechanical units have been designed with resource protection measures that conform to Klamath LRMP guidance in meeting the ACS and Riparian Reserve Standards and Guidelines, thus ensuring retention and, where needed, rapid re-establishment of soil cover.

CWE risk ratios (sediment indicators) indicate that mechanical treatments will not result in any "properly functioning" watershed degrading in status to "at risk" or worse. Potential impacts from these treatments would be negligible to minor with full recovery to pre-project conditions within a decade.

The prescribed underburning could potentially result in localized loss of soil and canopy cover, which would be of special concern in Riparian Reserves. Potential effects are increased sediment delivery to streams, increased stream temperature, and altered rates and patterns of LWD recruitment. All such effects would be detrimental to fish habitat.

Such events are expected to be few in number and limited in size by the fact that burn plans will incorporate retention of cover in conformance with Klamath LRMP guidance (ACS, Riparian Reserve Standards and Guidelines, BMPs, and related resource protection measures). This potential effect is expected to be negligible. Should such effects occur, they would be short term because regrowth and adjacent unburned stands would contribute to the rapid re-establishment of soil cover. The magnitude of this effect is virtually identical between Alternatives B and C because the locations and amounts of underburn treatments are nearly identical.

Underburning will be implemented consistent with guidelines in the *Biological Assessment and Evaluation for Pre-Commercial Thin and Release Actions and Fuel Reduction Actions on the Klamath National Forest* (USFS 2001), which limits burn prescriptions and design within Riparian Reserves, and establishes a cap on the amount of acreage that can be burned in a given year, to prevent adverse effects on aquatic habitat and fish.

Cumulative Effects on Fisheries Habitat under Alternative B (Beneficial Use "COLD")

Cumulative effects on fish are those effects of the project combined with other effects in the subject watersheds, including past natural disturbances and anthropogenic-induced effects and effects from reasonably foreseeable future projects.

Cumulative effects are also discussed in the April 2009 fish BA/BE for the Eddy Gulch LSR Project (this document is contained in the Eddy Gulch LSR Project Record). There are approximately 178 miles of streams in the Eddy Gulch LSR that provide habitat for steelhead and resident trout, and 7.8 miles of streams on private lands that provide habitat for steelhead and resident trout. The Eddy Gulch LSR includes 60,331 acres of Klamath National Forest lands and 2,323 acres of private lands. Reasonably foreseeable future actions on these private lands may include small-scale timber harvest and fuels reduction projects. These actions have the potential to increase sedimentation into these streams, possibly impacting habitat for these species. However, activities would occur under the State Forest Practice Rules that include measures to protect riparian and stream habitat. Thus, effects on salmonids and their habitat would be less than significant.

The actions proposed in Alternative B are consistent with guidelines in the *Biological Assessment and Evaluation for Pre-Commercial Thin and Release Actions and Fuel Reduction Actions on the Klamath National Forest* (USFS 2001), and they also comply with Standards and Guidelines in the Klamath LRMP (USFS 1995). These guidelines include measures to protect aquatic habitat and place a cap on the amount of underburning that occurs in a given year within a given watershed. The proposed treatments are not expected to cause adverse effects on anadromous fish, resident fish, or their habitat. This is based on previous consultation with NMFS, on the ground monitoring of the types of actions proposed, and field reviews of proposed treatment units (refer to the fish BA/BE prepared for the Eddy Gulch LSR Project Proposed Action).

Hazard trees removed along roads could cumulatively affect LWD in Riparian Reserves; however, LWD levels in Riparian Reserves would not be affected by hazard tree removal because the Klamath National Forest Hazard Tree Guidelines will be implemented and trees felled in Riparian Reserves will be left on site unless criteria are met for removal.

There would be no risk to viability for the anadromous fish described in this document because the needs of species influenced by federal land management activities will continue to be met through compliance with Klamath LRMP Standards and Guidelines. Additionally, it is expected that compliance the Standards and Guidelines will provide an amount and distribution of habitat adequate to support the continued persistence of vertebrate and nonvertebrate species in the analysis area.

The future foreseeable actions within in the analysis area are listed in Section 3.1 of the EIS. These projects are expected to have either no effect (fiber optic project) or to result in net improvement (North Fork Roads Stormproofing Project and fuelbreak system west of Black Bear Ranch (Table 7 above) to watershed conditions and aquatic resources. Private land activities in proximity to the LSR include domestic use and fuels reduction projects. The other activities (future timber sales, private land activities, recreation, mining, and watershed restoration) do not typically occur on the same land at the same time as the proposed actions. The physical and temporal separation between activities, low probability of sediment moving off site and into streams from proposed treatments, and the protective measures that will be implemented, all serve to minimize the risk of adverse cumulative effects on water quality, anadromous fish, and their habitat. Future

foreseeable actions would have either no effect or result in improvements to forest health and are not expected to cause additional impacts on fish or aquatic habitat.

Direct and Indirect Effects on Municipal / Domestic Uses of Water under Alternative B (Beneficial Use "MUN")

Direct effects on municipal / domestic uses of water are unlikely. The processes that most likely fit the definition of "direct effects" include damage to impoundments or delivery infrastructure or introduction of pollutants at points of diversion. Under Alternative B, no activities are proposed near known points of diversion or use that could produce such direct effects. Indirect effects would most likely be associated with accelerated sediment delivery to streams. Accelerated erosion and sedimentation can result in sediment deposition that damages diversion structures or renders them inoperative. High turbidity in water indicates the presence of particulates that can serve as substrates (and nutrients) for harmful microorganisms. Indirect effects on municipal / domestic use are evaluated in the bulleted items that follow.

- Construction of new temporary roads and re-opening of former logging access routes have the potential to increase sedimentation in streams, resulting in damage to water delivery systems or rendering water unfit for consumption. As previously discussed, the minor extent of road construction and their location away from streams and unstable slopes makes this effect highly unlikely. Points of diversion are typically located near residences in the lower portion of watersheds, which creates the maximum possible distance between disturbances and points of domestic use. This creates abundant opportunities for runoff infiltration and sediment deposition where it will not affect this beneficial use.

- Additionally, CWE model risk ratios suggest no significant increase in sediment delivery potential from all project activities, including road construction. The potential adverse effect of road construction on municipal / domestic uses of water would be negligible to minor, and the duration of effects would not exceed one decade.

- Mechanical treatments, mastication, and use of skid trails and landings could potentially increase the amount of soil disturbance, erosion, and sediment delivery to streams. Sediment indicators do not show significant increases for project activities, including mechanical treatments. The same rationale presented under Fish Habitat effects applies here. Low disturbance treatments, such as thinning and mastication, ridgetop and upper slope location, minimal overlap with Riparian Reserves, full implementation of resource protection measures, and extremely small increases in CWE risk ratios all support the conclusion of minimal impact on municipal / domestic use from project-related accelerated sedimentation.

The proposed action complies with the *Clean Water Act* through implementation of BMPs, meeting water quality objectives (suspended sediment, turbidity, and temperature), and protecting beneficial uses (USDA Forest Service 2007a). These actions ensure compliance with the *Clean Water Act* and North Coast Regional Water Quality Board Basin Plan. Further, projects must comply with the California Regional Water Board's Categorical Waiver for Discharges Related to Timber Harvest Activities on Federal Lands Managed by the United States Department of Agriculture, Forest Service in the North Coast Region, Order No. R1-2004-0015 (Waiver). The Eddy Gulch LSR Project meets all conditions and eligibility requirements of the Categorical Waiver.

Potential adverse effects from these treatments would be negligible to minor, with full recovery to pre-project conditions within a decade.

The prescribed underburning could potentially result in localized loss of soil and canopy cover, which would be of special concern in Riparian Reserves. When sufficiently extensive, this effect could increase sediment delivery to streams to a level that could impair domestic use of water. Such events are expected to be few in number and limited in size by the fact that burn plans will meet cover retention requirements in conformance with Klamath LRMP guidelines (ACS, Riparian Reserve Standards and Guidelines, BMPs, and related resource protection measures). This potential effect is expected to be negligible. Should such effects occur, they would be short term because regrowth and adjacent unburned stands would contribute to the rapid re-establishment of soil cover. The magnitude of this effect is virtually identical between Alternatives B and C because the locations and amounts of underburn treatments are nearly identical.

Cumulative Effects on Municipal / Domestic Uses of Water (Beneficial Use "MUN")

No evidence was found to indicate that existing sediment or turbidity levels cause impairment to municipal / domestic uses of water. Because the CWE model input includes information from past and foreseeable future projects, its output offers the best quantitative assessment of potential cumulative effects on municipal / domestic use in the form of accelerated sedimentation. Listed municipal watersheds include Eddy Gulch, Black Bear Creek, Shadow Creek, Callahan Gulch, Counts Gulch, Crawford Creek, and Music Creek. Of these, Eddy Gulch and Shadow Creek are the only drainages with CWE risk ratios that could be described as "at risk." Table 7 shows Eddy Gulch with a USLE risk ratio of 0.90, which represents existing condition plus effects of foreseeable future projects. This increases very slightly to 0.91 in 2014 when all road construction and mechanical treatments are complete. The same risk ratio for Shadow Creek is 0.93, increasing to 0.96 in 2014. These increases are extremely small and likely not significant. No other risk ratios for municipal watersheds are in the "at risk" or higher range.

Cumulative adverse effects from project activities, when superimposed on past and foreseeable future actions, are expected to be negligible to minor. Full recovery to pre-project conditions, as judged from CWE risk ratios, is likely upon project completion in 2021.

1.8.3 Alternative C: No New Temporary Roads Constructed

As mentioned in the discussion of Alternative B, the differences between the two action alternatives are very small. The 1.03 miles of new temporary roads would not be constructed under Alternative C, and as a result, 99 acres in M Units and 822 acres in Rx Units would not be treated. This reduction in thinning acres would affects M Units 15, 17, 21, 24, 36, 37, and 75. The magnitude of differences between the two action alternatives relative to potential effects on fish and their habitat are very small because mechanical units and the proposed temporary roads would be located on or near ridgetops and not in Riparian Reserves.

Because the differences between the action alternatives are so small, most of the discussion of potential effects presented under Alternative B is applicable to Alternative C. Rather than repeat those sections, the discussion that follows only focuses on the differences in effects on aquatic resources.

The design features applicable to both action alternatives include BMPs, WWOS, forestwide soil cover standards, as well as Klamath LRMP Standards and Guidelines. Application of these measures would minimize the effects of proposed treatments equally under both alternatives.

Actions with Potential to Affect Sediment Indicators

Road construction. There would be no construction of the 1.03 miles of new temporary roads, but the former logging access routes (0.98 mile) would still be re-opened (vegetation removed and bladed) to access all or portions of five M Units for yarder access and skidding of logs. Other than this change, this discussion under this heading for Alternative B is equally applicable to Alternative C.

Skid trails, landings, and cable corridors associated with thinning units. All of the 99 acres of thinning that are eliminated under Alternative C were proposed for cable yarding because of slope steepness. This will produce a slight decrease in the potential for soil disturbance. The landings (and associated skid trails) proposed for tractor yarding in the thinning units will remain part of Alternative C. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Mastication of fuels. See discussion under Alternative B (no change).

Prescribed underburning. Approximately 822 acres in Rx Units have been eliminated from Alternative C. This change, when taking into consideration the overall amount of proposed underburning, would result in a negligible difference between the effects of Alternatives B and C; therefore, the rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Water drafting. See discussion under Alternative B (no change).

Wildfire and its suppression. Not thinning the 99 acres within ridgetop FRZs and not treating 822 acres in Rx Units may slightly reduce the effectiveness of treatments relative to the risk of stand-replacing wildfire and its associated increase in erosion and sedimentation. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Actions with Potential to Affect Flood Regime Change Indicator

Road construction. The slight reduction in road construction is too small to have any measurable effect on the potential for flood regime change. No effect is expected from Alternative B, so none would be expected from Alternative C. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Skid trails, landings, and cable corridors associated with thinning units. No adverse effect on flood regime change is expected from Alternative B so none would be expected from Alternative C in which overall soil disturbance is slightly less. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Mastication of fuels. See discussion under Alternative B (no change).

Prescribed underburning. Since underburning does not create impervious surface, the 99 acre increase is unlikely to produce an adverse effect. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Water drafting. See discussion under Alternative B (no change).

Wildfire and its suppression. Not thinning on 99 acres within ridgetop FRZs and not treating 822 acres in Rx Units may slightly reduce the effectiveness of treatments relative to the risk of stand-replacing wildfire and its associated potential to increase the amount of impervious surface. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Actions with Potential to Affect Stream Temperature Indicator

Road construction. See discussion under Alternative B (no change).

Skid trails, landings, and cable corridors associated with thinning units. Under Alternative B, eight thinning units required SMZs because of overlap or adjacency with seasonal stream (nonperennial streams) Riparian Reserves. Three of those units (M15, M21, and M24—all in Shadow Creek) would have thinning acres reduced from 144 to 62 acres in cable units. Whether this would increase or decrease the probability of creating undesired openings in Riparian Reserve canopy is unclear. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Mastication of fuels. See discussion under Alternative B (no change).

Prescribed underburning. See discussion under "Skid trails, landings, and cable corridors associated with thinning units."

Water drafting. See discussion under Alternative B (no change).

Wildfire and its suppression. Not thinning on 99 acres within ridgetop FRZs may slightly reduce the effectiveness of treatments relative to the risk of stand-replacing wildfire and its associated potential to consume portions of Riparian Reserves. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Actions with Potential to Affect Large Woody Debris Recruitment Indicator

Road construction. See discussion under Alternative B (no change).

Skid trails, landings, and cable corridors associated with thinning units. Under Alternative B, eight thinning units required SMZs because of overlap or adjacency with seasonal stream (nonperennial streams) Riparian Reserves. Three of those units (M15, M21, and M24—all in Shadow Creek) would have thinning acres reduced from 144 to 62 acres in cable units. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Mastication of fuels. See discussion under Alternative B (no change).

Prescribed underburning. See discussion under "Skid trails, landings, and cable corridors associated with thinning units."

Water drafting. See discussion under Alternative B (no change).

Wildfire and its suppression. Not thinning on 99 acres within ridgetop FRZs and the reduction of 822 acres in Rx Units may slightly reduce the effectiveness of treatments relative to the risk of stand-replacing wildfire and its associated potential to consume portions of Riparian Reserves. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Hazard tree removal. The removal of hazard trees along roads could potentially affect LWD in Riparian Reserves under both action alternatives. However, the Klamath National Forest Hazard Tree Guidelines will be implemented and trees felled within Riparian Reserves would be left on site, so the LWD levels in Riparian Reserves would not be affected by hazard tree removal.

Actions with Potential to Affect the Road Density Indicator

Road construction. The discussion under Alternative B highlighted the extremely small increases in road density associated with 1.03 miles of new temporary road construction. The deletion of 1.03 miles of proposed temporary road segments under Alternative C results in pre-project road density, as shown below.

	Pre-project (mi/mi^2)	Alternative B Post-project (mi/mi^2)	Alternative C Post-project (mi/mi^2)
Black Bear Creek	2.67	2.69	2.67
Crawford Creek	3.09	3.12	3.09
Shadow Creek	2.73	2.85	2.73

The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Skid trails, landings, and cable corridors associated with thinning units. These actions would not affect road density.

Mastication of fuels. This action would not affect road density.

Prescribed underburning. This action would not affect road density.

Water drafting. This action would not affect road density. Existing access roads would be used.

Wildfire and its suppression. These actions would not affect road density.

Direct and Indirect Effects on Fisheries Habitat under Alternative B (Beneficial Use "COLD")

Water drafting from streams has the potential to adversely affect fish by temporarily dewatering channels and entraining young fish into pump intakes. Existing water drafting sites will be used. The incorporation of NMFS (2001b) Water Drafting Specifications as resource protection measures will prevent these impacts. Erosion control and drainage will prevent sedimentation and turbidity increases. This impact assessment is identical between Alternatives B and C.

Construction of new temporary roads and re-opening of former logging access routes have the potential to increase sedimentation in streams and degrade fish habitat. Under Alternative B, this potential for this impact was evaluated as negligible to minor. Because Alternative C eliminates 1.03 miles of new temporary road construction, but retains use of the 0.98 mile of former logging access routes, the impact would be slightly less under Alternative C and still negligible to minor. The duration of effects would not exceed one decade.

Mechanical treatments, mastication, and use of skid trails and landings could potentially increase the amount of soil disturbance, erosion, and sediment delivery to streams. Alternative C contains 99 fewer acres of thinning, thus slightly reducing the magnitude of this impact. However, the magnitude of adverse effects under Alternative B was determined to be negligible, thus the reduction would be discountable. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

This potential adverse effects under Alternative B was judged to be negligible to minor. With even fewer acres receiving mechanical treatment under Alternative C, potential effects on fish habitat from these treatments would be negligible to minor, with full recovery to pre-project conditions within a decade.

The prescribed underburning could potentially result in localized loss of soil and canopy cover, which would be of special concern in Riparian Reserves. Approximately 822 acres of Rx Units have been eliminated from Alternative C. This change, when taking into consideration the overall amount of proposed underburning, would result in a negligible difference between the effects of Alternatives B and C; therefore, the rest of the discussion under this heading for Alternative B is equally applicable to Alternative C. The duration of effects is expected to be 5–10 years due to rapid re-establishment of ground cover from adjacent stands.

Cumulative Effects on Fisheries Habitat under Alternative C (Beneficial use "COLD")

See discussion under Alternative B because it is equally applicable to Alternative C. The differences in cumulative effects on fish between the action alternatives are discountable. Based on the same rationale presented for Alternative B, cumulative effects, including the proposed treatments, are considered to be minor.

Direct and Indirect Effects on Municipal / Domestic Uses of Water under Alternative C (Beneficial Use "MUN")

Direct effects on municipal / domestic uses of water are unlikely. Damage to impoundments or delivery infrastructure or introduction of pollutants at points of diversion are the most likely processes fitting the definition of "direct effect." Under Alternative C, no activities are proposed near known points of diversion or use that could produce such direct effects. Indirect effects would most likely be associated with accelerated sediment delivery to streams. Accelerated erosion and sedimentation can result in sediment deposition that damages diversion structures or renders them inoperative. High turbidity in water indicates the presence of particulates that can serve as substrates (and nutrients) for harmful microorganisms. Indirect effects on municipal / domestic use are evaluated in the bulleted items that follow:

- Construction of new temporary roads and re-opening of former logging access routes have the potential to increase sedimentation in streams resulting in damage to water delivery

systems or rendering water unfit for consumption. Alternative C does not propose construction of the 1.03 miles of temporary roads, but the 0.98 mile of former logging access routes would still be re-opened. Based on the same rationale presented for Alternative B, it is concluded that the potential adverse effects on municipal use from road-generated sediment would be negligible to minor. The duration of effects would not exceed one decade.

- Mechanical treatments, mastication, and use of skid trails and landings could potentially increase the amount of soil disturbance, erosion, and sediment delivery to streams. Alternative C contains 99 fewer acres of thinning, thus slightly reducing the magnitude of this impact. The rest of the discussion under this heading for Alternative B is applicable to Alternative C.

This potential adverse effects that would result from implementation of Alternative C were judged to be negligible to minor: The actions do not cause CWE values to exceed thresholds as concluded supported by the CWE modeling done for Alternative C (addendum to the CWE report prepared by KNF Hydrologist, Gregg Bousfield, October 22, 208) and field reviews verified that no significant adverse effects to water quality or aquatic habitat would occur. With even fewer acres receiving mechanical treatment under Alternative C, it is concluded that potential adverse effects on municipal / domestic use from these treatments would be negligible to minor, with full recovery to pre-project conditions within a decade.

The prescribed underburning could potentially result in localized loss of soil and canopy cover, which would be of special concern in Riparian Reserves. Approximately 822 acres of Rx Units have been eliminated from Alternative C. This change, when taking into consideration the overall amount of proposed underburning, would result in a negligible difference between the effects of Alternatives B and C, as is the conclusion that the magnitude of effects would be negligible to minor; therefore, the rest of the discussion under this heading for Alternative B is equally applicable to Alternative C. The duration of effects is expected to be 5–10 years due to rapid re-establishment of ground cover from adjacent stands.

Cumulative Effects to Municipal / Domestic Uses of Water under Alternative C (Beneficial Use "MUN")

See discussion under Alternative B as it is equally applicable to Alternative C. The differences in cumulative effects to municipal / domestic uses between the action alternatives are discountable. Based on the same rationale presented for Alternative B, cumulative effects including the proposed actions are considered to be minor.

1.9 Resource Protection Measures

1.9.1 Fisheries

1.9.1.1 Streamside Protection

- Except where a masticator is used, fuel treatments on all units may occur within 30 feet of intermittent or perennial streams less than 1-foot wetted width.

- Handpiling and pile burning may occur within 15–30 feet of intermittent or small perennial streams in areas where treatment units are not located on granitic soils, or where the sideslopes entering intermittent and small perennial channels do not exceed 35 percent, or where soil cover estimates within 15 feet of the intermittent or small perennial streams are greater than 50 percent. For perennial streams greater than 1-foot wetted width, handpiling with no burning may occur within 15–30 feet of the streambank. The guidelines for this to occur are as follows:

  – Demonstrate through a series of appropriately placed plots that estimated soil cover exceeds 50 percent within the adjacent 15-foot no-handpile buffer (15 feet adjacent to streambank);

  – Handpiles will be spread out and not be "stacked" above one another where, during burning, they could connect and affect a greater area than anticipated; or a linear area is developed that will increase the potential for erosion to occur;

  – Handpiles will be small in size—6 feet or less in diameter; and

  – Handline construction in riparian vegetation shall be avoided where practical.

- Logs will be suspended when being yarded across channels. Skid trail crossings of localized, hydrologically disconnected ephemeral channels (no Riparian Reserves present) will be uncommon and in such cases require remedial shaping.

1.9.1.2 Underburning

- No more than 10 percent of a 6th-field watershed will be burned in any one year in order to minimize the potential for cumulative adverse effects when underburning.

- Handlines in Riparian Reserves will be waterbarred and covered with organic material immediately following prescribed burning, when safe to do so.

1.9.1.3 Mastication

The following guidelines will apply when a masticator is used:

- Soil moistures will be below 18 percent.

- The track-mounted excavator will not operate within 50 feet of any perennial / intermittent stream less than 1-foot wetted width; however, the arm of the masticator may reach within this 50-foot buffer to treat competing vegetation (approximately a 30-foot reach). For perennial streams greater than 1-foot wetted width, a 100-foot buffer will be designated.

- The track-mounted excavator will not operate beyond break in slope of any inner gorge.

- Dry intermittent streams may be crossed by the track-mounted excavator / masticator at designated sites only after field review and approval by district fisheries biologist and/or hydrologist. No perennial streams will be crossed.

1.9.1.4 Water Drafting

All project water drafting will follow National Oceanic and Atmospheric Administration (NOAA)-Fisheries Water Drafting Specifications (NMFS 2001b), including, but not limited to the following:

- Drafting will not reduce the stream flow by more than 10 percent.
- When water is drafted, intakes will be screened with 3/32-inch mesh (for rounded or square openings) or 1/16-inch mesh for slotted opening.
- Pumping rate shall not exceed 350 gallons per minute or 10 percent of the stream flow.
- Pumping will be terminated when the water tank is full.
- Water drafting sites for dust abatement on roads will occur at designated sites for that purpose. Erosion-control measures will be employed on the access and / or main road to prevent water leakage from causing stream sedimentation. Hazardous material spill prevention and containment equipment will be present on water trucks. Water trucks and pumping equipment will be in a well-maintained condition, free of fluid leaks, and have hoses in good operating condition.

1.9.1.5 Special Areas

Refer to the Fish Biological Assessment / Biological Evaluation in the Eddy Gulch LSR project record for detailed information on "Areas With Watershed Concerns" and the cumulative watershed effects (CWE) analysis conducted for the project. Based on CWE assessments and field reviews, the proposed Eddy Gulch LSR Project treatment units were located and designed to avoid and protect sensitive areas in these watersheds to ensure cumulative effects do not result in adverse effects on Proposed (or Listed) anadromous fish or their habitat. The proposed treatments were designed to reduce the effects of wildfire but would not reduce CWEs due to existing main roads located in Riparian Reserves.

1.9.1.6 Riparian Reserves

- The Riparian Reserves have been mapped (Maps A-6a and A-6b). The Klamath LRMP defines standard slope distance for Riparian Reserves as two site-potential tree heights or 300 feet for anadromous and resident fish-bearing streams (whichever is greater) and one site-potential tree height or 150 feet for nonfish-bearing streams (whichever is greater). This project defines one site-potential tree height as 170 feet on each side of a qualifying stream channel. Therefore, the Riparian Reserve width is 340 feet for fish-bearing streams and 170 feet on each side of an active stream channel for nonfish-bearing streams.
- As a handline is being built into a draw, stop building the handline within 25 feet of the wetted edge of the channel to minimize disturbed soil adjacent to the stream.
- Prescribed fire will be ignited in a manner that minimizes the potential for moderate- or high-intensity burns.

- When underburning in Riparian Reserves, at least 90 percent of the LWD will not be consumed, both standing and on the ground.

- All entry to waterways occupied by spawning anadromous fish or where eggs would be incubating, as determined and indicated by a Fisheries Biologist, is prohibited. Restricted time periods are generally from October 15 through June 15. Additional restrictions may be appropriate for waterways containing Spring Chinook Salmon and summer-run steelhead, as determined by the District Fisheries Biologist. (The focus is protection of spawning and incubating eggs.)

- Where more than 80 percent shade exists, at least 80 percent shade on the water will be retained after treatment.

- Larger conifers (greater than 20 inches dbh) felled within perennial stream channels or inner gorges, will be left. However, slash will be minimized in the stream channel.

- Units with active landslides and toe zones may require field-based evaluation by a geologist or other earth scientist and a silviculturist to consider and refine treatments.

- BMPs and WWOS (USFS 2002a) will be implemented during all activities.

- No new landings will be constructed in Riparian Reserves.

1.9.1.7 Aquatic Conservation Strategy (ACS) Objectives

ACS objectives 1, 3, 4, 5, 6, 8, and 9 pertain to the proposed alternatives. ACS objectives that may not pertain are 2 and 7. Spatial and temporal connectivity within and between watersheds (ACS Objective 2) would not be affected by these activities because very little to no activity would occur within anadromous reaches. In addition floodplain inundation and water table elevation in meadows and wetlands (ACS Objective 7) would also not be affected by this activity because little to no activity would occur within these habitats.

1. The proposed alternatives maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.

   Thinning and underburning in M Units will move stands out of the dense, closed-canopy stage and accelerate the development of conditions found in pre-European late-successional forests. Thinning in M Units can also promote growth of residual conifers, resulting in stands dominated by larger trees.

3. The proposed alternatives would maintain the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

   Channel features would not change as a result of implementing the proposed actions, along with implementing BMPs, WWOS, Klamath LRMP Standards and Guidelines, and the resource protection measures outlined in the fish BA/BE for the Eddy Gulch Project.

4. The proposed alternatives would maintain water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

   All mechanical tree removal would occur on ridgetops, removed from water courses. Water quality will be protected and have no changes as a result of implementing BMPs, WWOS, Klamath LRMP Standards and Guidelines, and the resource protection measures outlined in the fish BA/BE for the Eddy Gulch LSR Project.

5. The proposed alternatives would maintain the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

   The sediment regime would not change as a result of implementing BMPs, WWOS, Klamath LRMP Standards and Guidelines, and the resource protection measures outlined in the fish BA/BE for the Eddy Gulch LSR Project.

6. The proposed alternatives would maintain in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

   Peak/base flows would have negligible changes due to the small number of units being treated during any one year in a particular drainage. Implementation of NMFS (2001) water drafting guidelines would protect base flows during project implementation.

8. The proposed alternatives maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distribution of coarse woody debris sufficient to sustain physical complexity and stability.

   Thinning and/or underburning in M Units will move stands out of the dense, closed-canopy stage and accelerate the development of conditions found in pre-European late-successional forests. Thinning in M Units can also promote growth of conifers already present, resulting in a more diverse forest structure. Fuels hazard reduction would move treated stands towards being more resilient to wildfire, thereby reducing the probability of a stand-replacing wildfire and its effects.

9. The proposed alternatives would protect and maintain habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

   Thinning and underburning in M Units can move stands out of overly dense conditions and accelerate the development of conditions found in pre-European late-successional forests. Thinning and underburning in M Units can promote growth of conifers already present, resulting in a more diverse forest structure. Fuels hazard reduction can move the stand into being more resilient against wildfire, thereby reducing the probability of a stand-replacing wildfire event occurring in that particular stand and an increased probability of the stand surviving the inevitable wildfire event.

As a result of the increased growth that would be realized from the thinning in M Units, beneficial long-term water temperature effects could be evident sooner than if no thinning took place.

1.9.2 Water Resources

- Implement BMPs.

- Water drafting sites for dust abatement on roads will occur at designated sites for that purpose. Erosion-control measures will be employed on the access and/or main road to prevent water leakage from causing stream sedimentation. Hazardous material spill prevention and containment equipment will be present on water trucks. Water trucks and pumping equipment will be in a well-maintained condition, free of fluid leaks, and have hoses in good operating condition.

- Refueling and maintenance of project motorized equipment, including helicopters, will occur at least 200 feet away from any channel (USFS 2003).

- Mulch or slash any skid trails on slopes over 35 percent. Slash or certified straw will be placed on them to achieve a 70–80 percent soil cover.

- The new temporary roads will be closed (hydrologically restored) at project completion. The temporary roads will be outsloped (as necessary), covered with slash (if needed), and blocked after use (prior to the first winter after use). Road closure includes obliteration (recontouring) of temporary road segments; removal of berms and fills, any constructed stream crossing (none anticipated), tillage or scarification of compacted areas, waterbars, and slash or mulch cover of disturbed areas to 70 percent.

- Apply erosion control measures to the new temporary roads and former logging access routes that will be used during the project.

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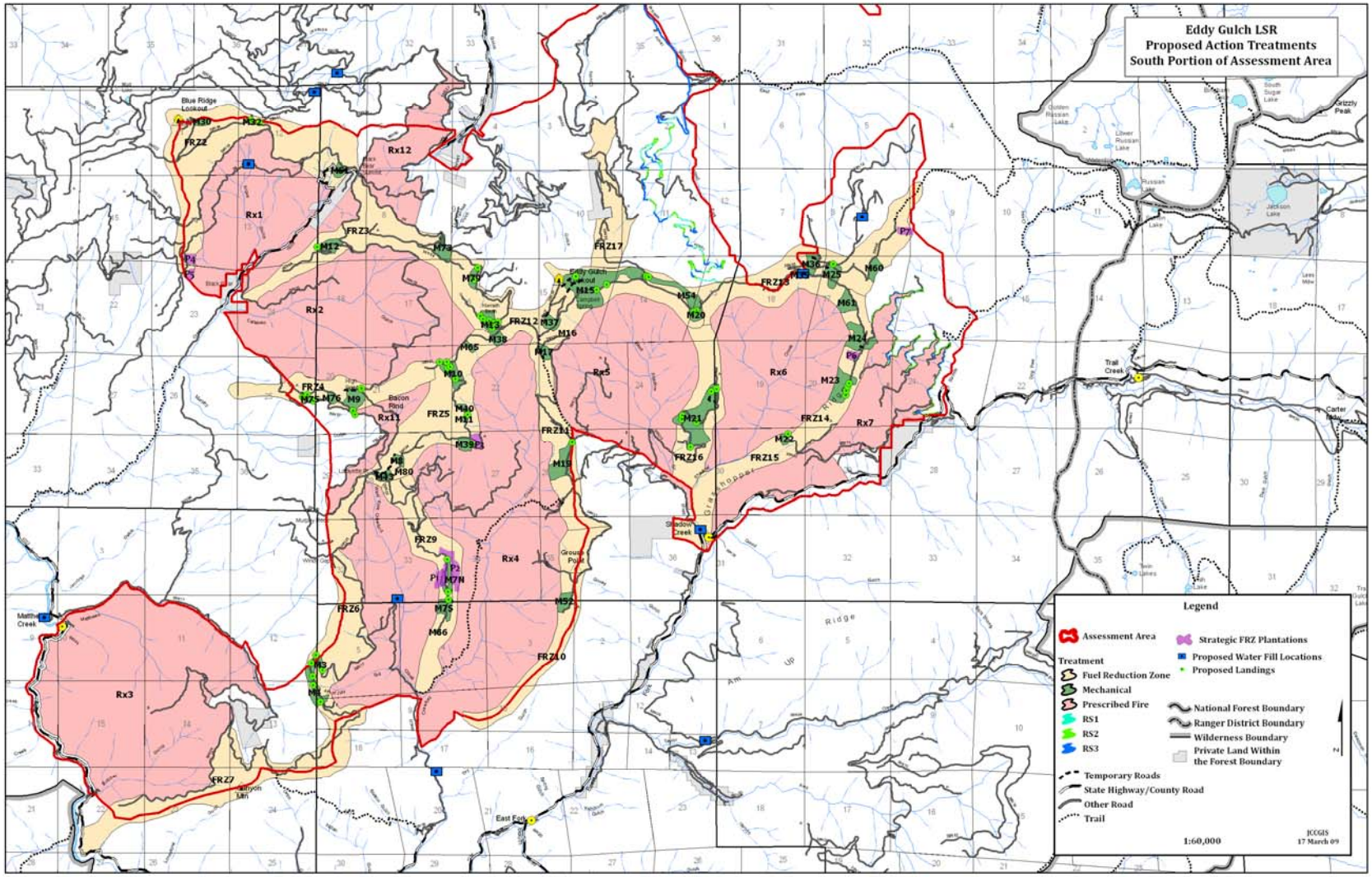
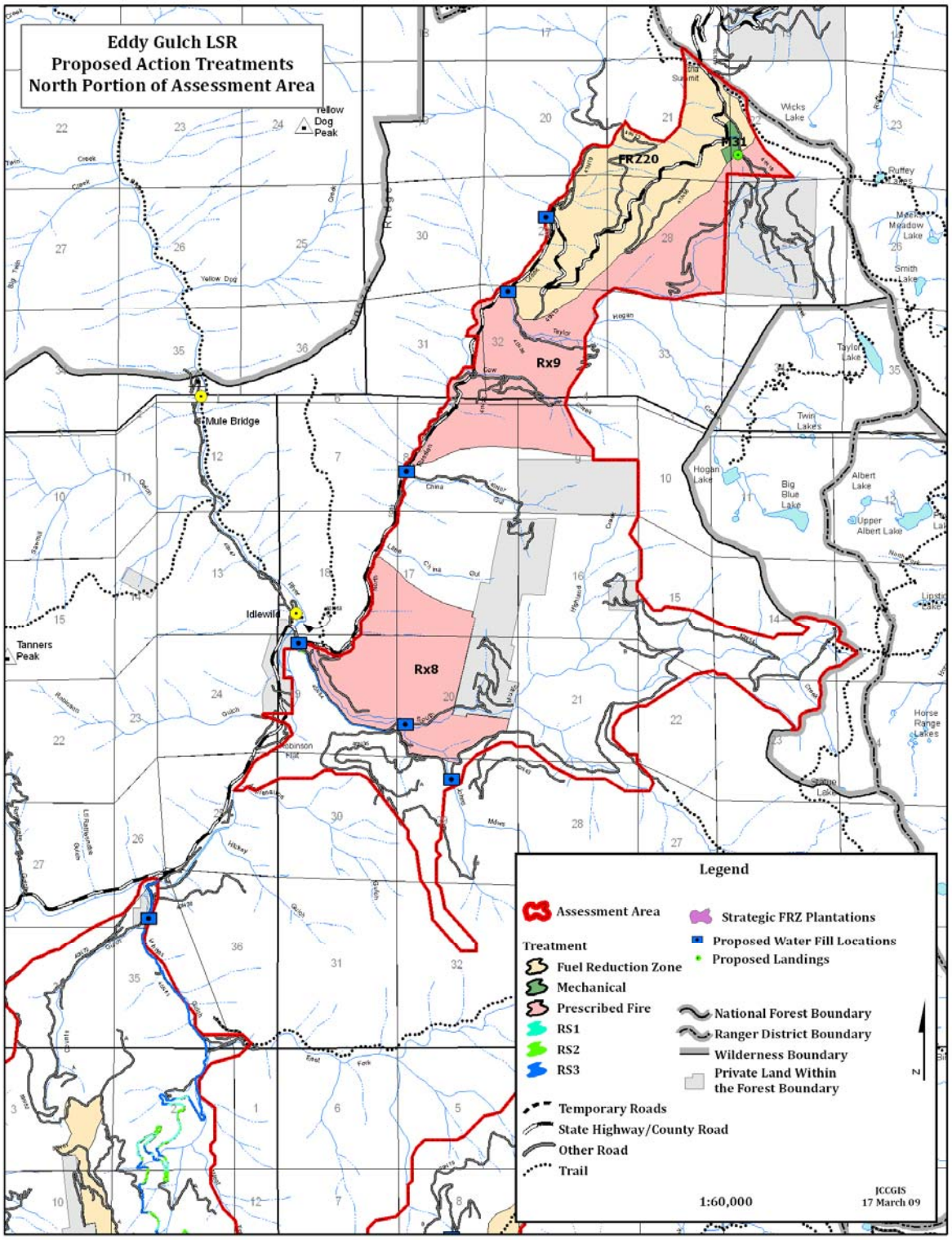
Appendix A
Project Maps

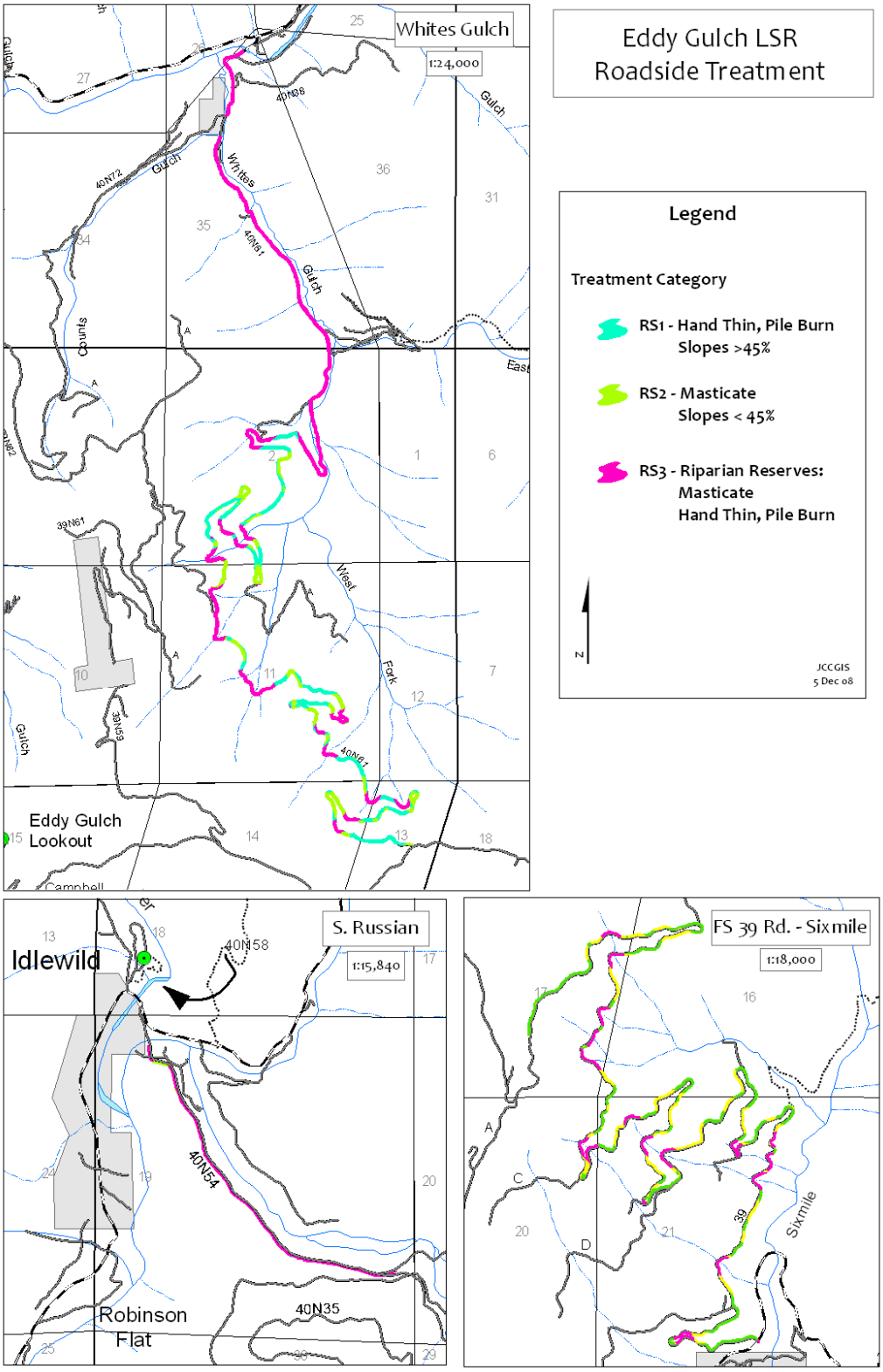
Map A-1. Proposed treatment units in the south portion of the Eddy Gulch LSR Project Assessment Area.



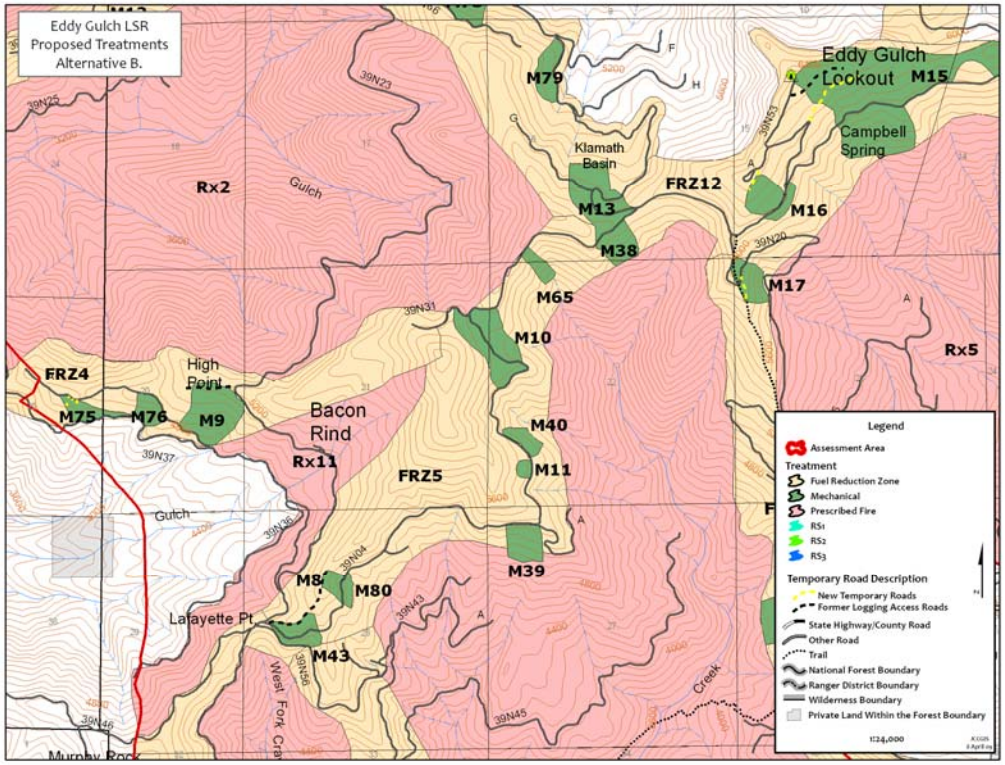
Map A-2. Proposed treatment units in the north portion of the Eddy Gulch LSR Project Assessment Area.

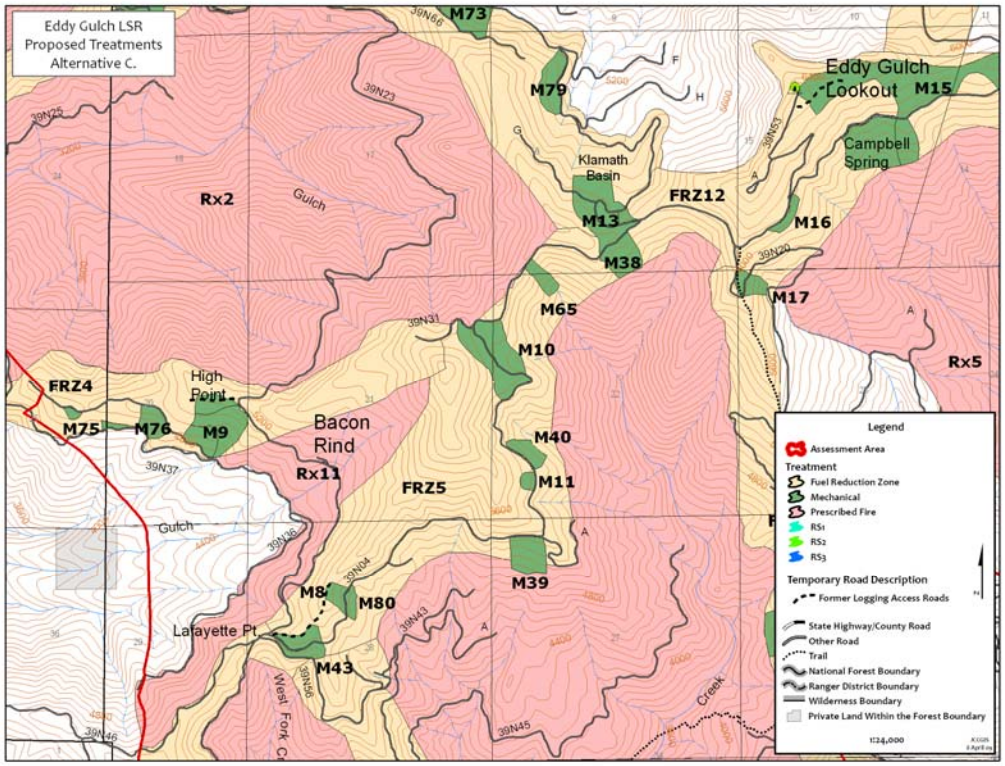


Map A-3. RS treatments along emergency access routes that do not pass through an FRZ or Rx Unit.

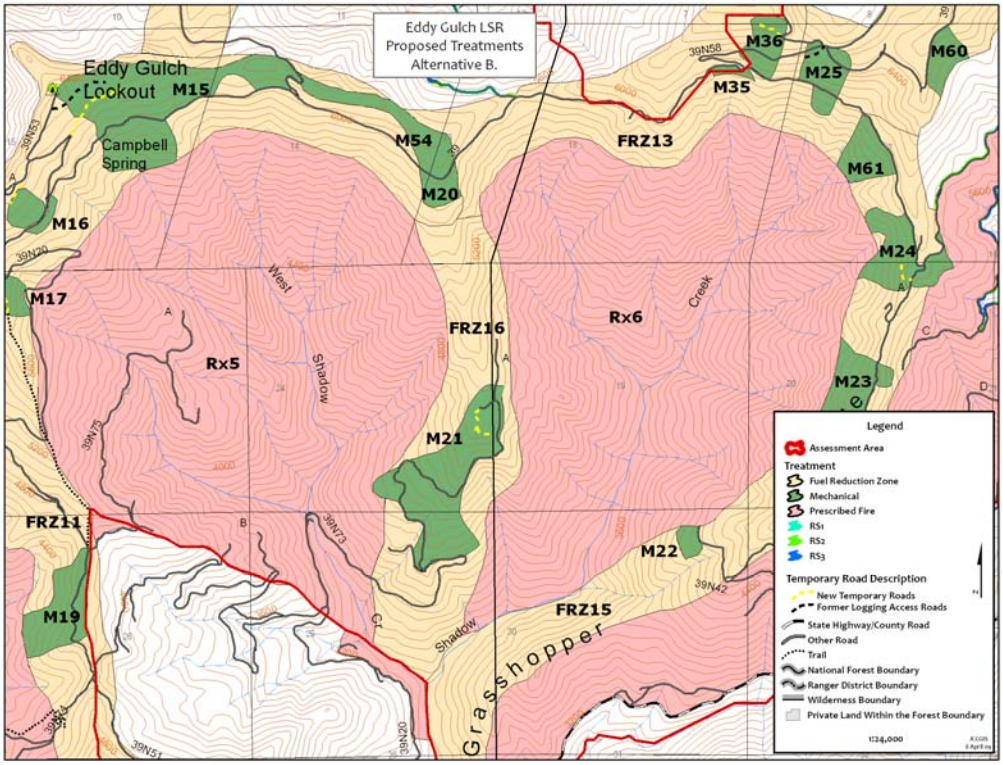


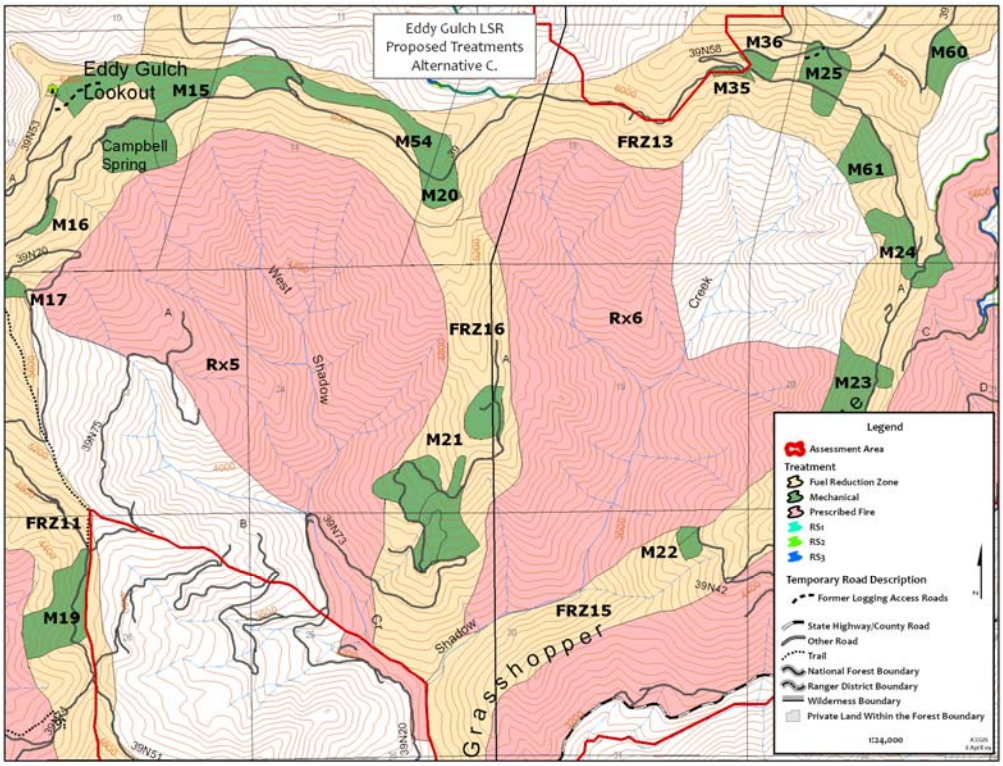
Map A-4a. View 1: Alternative B–configuration of treatment units *with construction* of 1.03 miles of new temporary roads and Alternative C–configuration of treatment units *without construction* of 1.03 miles of new temporary roads.



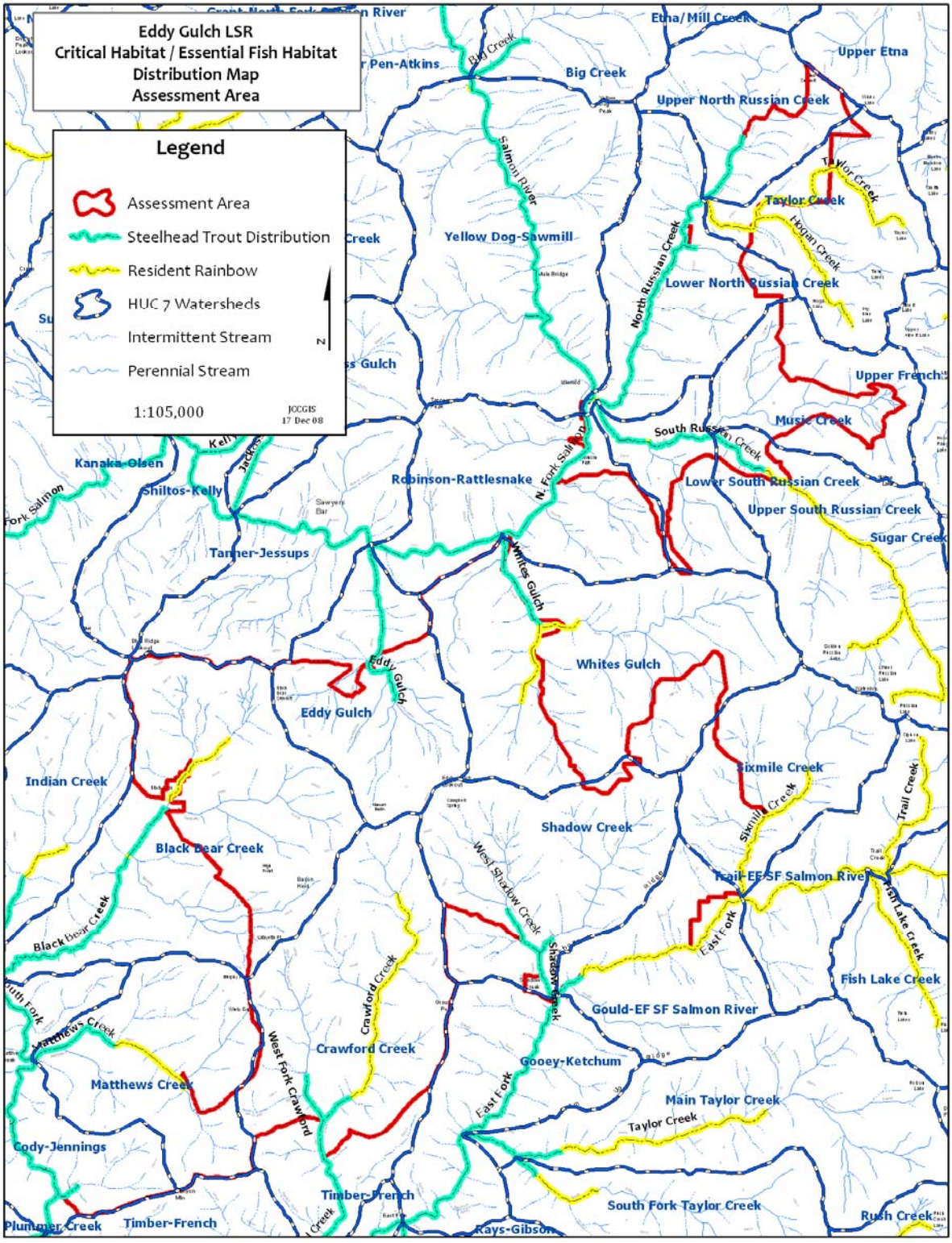


Map A-4b. View 2: Alternative B–configuration of treatment units *with construction* of 1.03 miles of new temporary roads and Alternative C–configuration of treatment units *without construction* of 1.03 miles of new temporary roads.

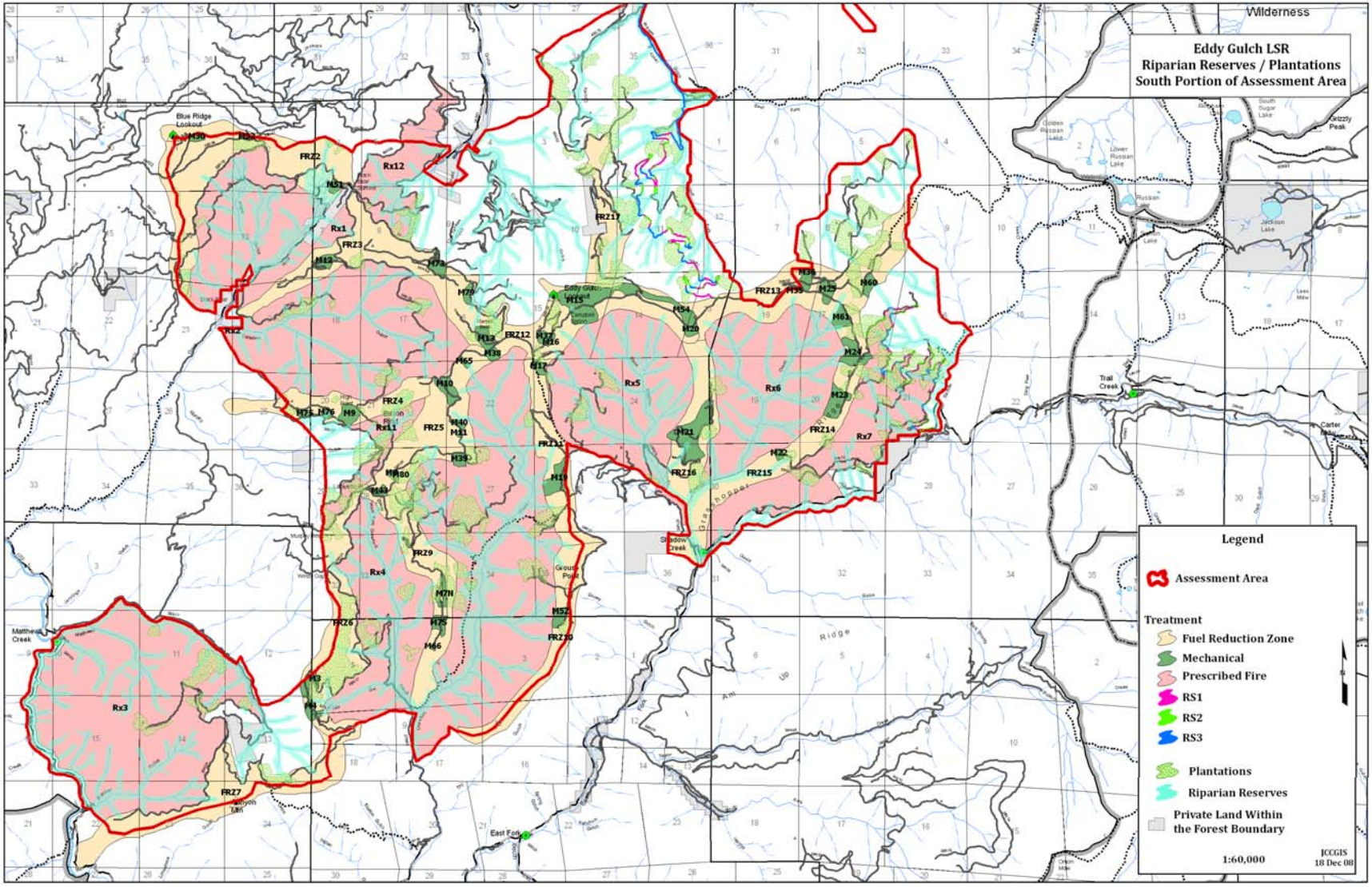




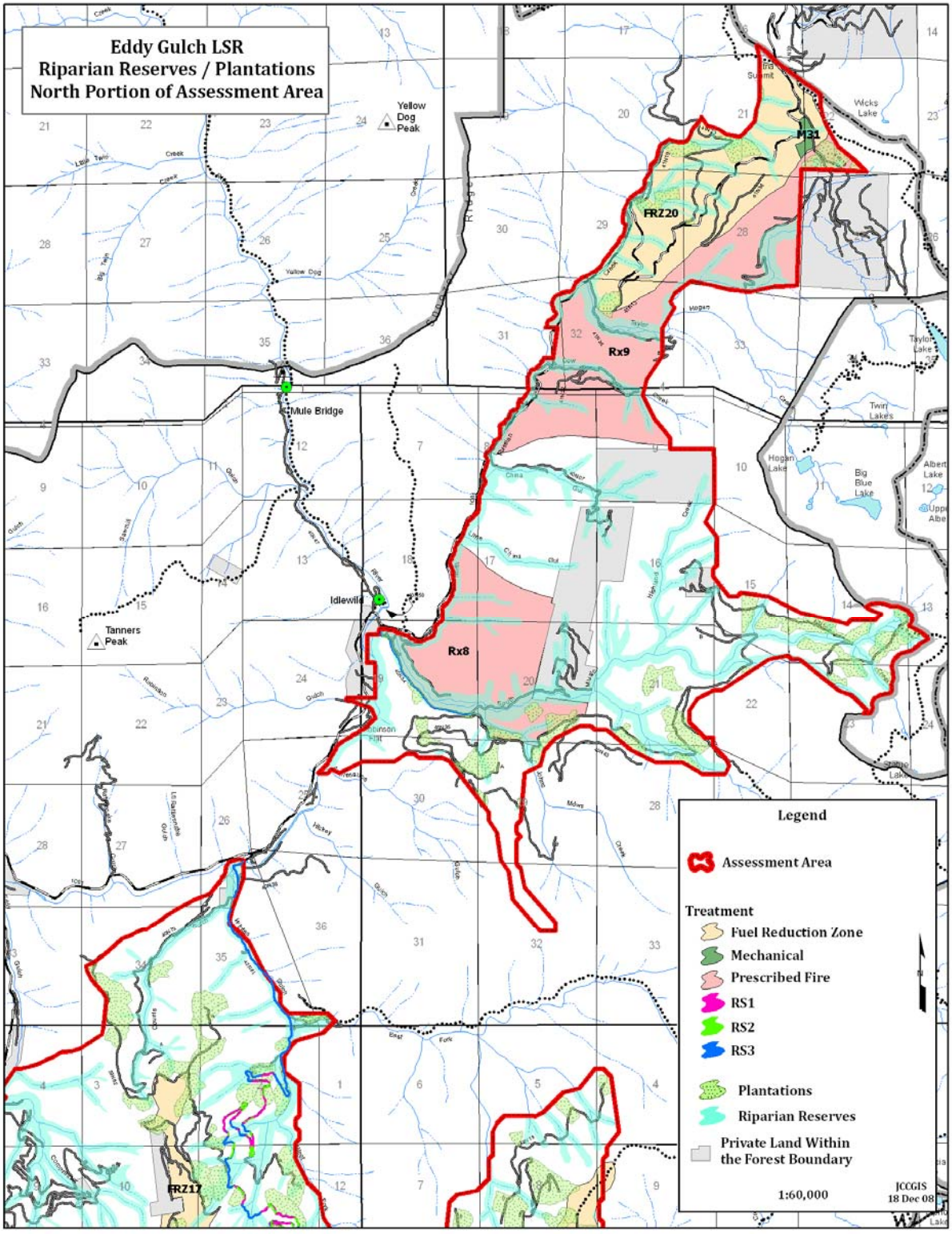
Map A-5. Distribution of anadromous and resident salmonids in the Eddy Gulch LSR Assessment Area.



Map A-6a. Locations of Riparian Reserves and plantations in the south portion of the Eddy Gulch LSR Project Assessment Area.



Map A-6b. Locations of Riparian Reserves and plantations in the north portion of the Eddy Gulch LSR Project Assessment Area.



Appendix B

Project-wide Guidelines on Best Management Practice Implementation

Appendix B
Project-wide Guidelines on
Best Management Practice Implementation

The italicized text in this section was excerpted from the Watershed Specialist Report for the Mt. Ashland LSR project prepared by Robbie Vandewater. Its content has been reviewed and found to be pertinent to the Eddy LSR project (with some minor editing).

> *Best Management Practices (BMPs) are measures certified by the State Water Quality Board and approved by the Environmental Protection Agency (EPA) as the most effective way of protecting water quality from impacts stemming from non-point sources of pollution. These practices have been applied in timber sales and road construction projects in this and other watersheds and have been found to be effective in achieving their stated objectives within the Klamath Basin.*
>
> *Forest Service BMPs have been monitored and modified over several decades to make them more effective. On-site evaluations by State regulatory agencies found the practices were effective in protecting beneficial uses.*
>
> *Calendar year 2006 was the fifteenth year of the Best Management Practices Evaluation Program (BMPEP) on the Klamath National Forest and the Forest Service Pacific Southwest Region (Region). This program is designed to evaluate how well the Forest and the Region implement BMPs, and how effectively the BMPs control water pollution from National Forest lands. Onsite evaluations have been divided into 28 evaluation categories that reflect related timber, roads, mining, recreation, vegetation management, fire, watershed, and range practices. In 2006, BMPs were fully implemented at 93% of the sites evaluated and effective at 100% of the sites evaluated (water quality was protected at some sites even if BMPs were not fully implemented). This represents a slight change in BMP implementation (a 3% decrease) and effectiveness (a 2% increase) compared to 2005.*

BMP 1.1 – Timber Sale Planning Process*: Requires the Interdisciplinary Team (IDT) to consider methods of reducing water quality impacts during the planning phase of a project. This is accomplished during the planning process of the Timber Sale project.*

- For determining Riparian Reserve (RR) buffer widths, one site potential tree height was designated as 170 feet for the Project.
- Stream shading will not be reduced below 80 percent to maintain water temperature.
- Masticating equipment may operate on slopes up to 45 percent.
- Tractor yarding equipment is generally limited to slopes <35 percent.
- Existing skid trails will be reused whenever possible.
- Existing landings will be reused whenever possible.
- Tractor skidding will occur on designated skid trails. Tractors may leave skid trails to access isolated logs if ground conditions permit. End lining will be employed on slopes greater than 35 percent (see also BMP 5.2).

- The temporary roads will be outsloped and blocked after the harvest season (prior to the first winter after use). The temporary roads will be decommissioned (hydrologically restored) at project completion.

- Water drafting sites are existing sites and rocking of approaches will be used as required; all boards and plastic will be removed after use.

- Watershed personnel reviewed all proposed landings and new roads in the field to determine if unstable areas or other watershed issues were present and documented findings in project reports.

- Unstable areas will be reviewed by an earth scientist prior to actual landing construction and mitigated or avoided.

- Swing Boom Yarding (SBY) will be required within the timber sale contract to help alleviate the need to enlarge existing landings or construct additional landings.

BMP 1.2 – Timber Harvest Unit Design*: Requires the IDT to consider methods of reducing water quality impacts due to changes in unit design. This is accomplished during the planning phase of a project. Examples of design changes are restricting timing of tree removal and utilizing less impacting yarding systems.*

- The IDT reviewed all units to select harvest methods appropriate to site conditions.

- Tractor yarding equipment is generally limited to slopes <35 percent. This is incorporated into the unit layout.

- Heavy equipment will be kept approximately 50 feet from the break in slope to the wetted channel or inner gorge of intermittent streams channels.

BMP 1.3 – Use of Erosion Hazard Rating for Unit Design*: Identifies high or very high erosion hazard areas and adjust management activities to prevent downstream water quality impacts; and to increase soil cover for those areas that have a high risk of contributing sediment into streams. This is done during the planning and layout phase of the project.*

- Based on field review and site data (percent slope distribution, soil texture), the Soil Scientist determined the surface erosion hazard rating for each treatment unit and prescribed logging systems and soil cover needs based on the erosion hazard rating.

- Some unit boundaries were defined by equipment slope limitations for skidders at 35 percent. Low ground pressure masticators have a slope limitation of 45 percent.

BMP 1.4 – Use of Sale Area Maps for Designating Water Quality Protection*: Identifies sensitive areas and water uses as part of the Timber Sale contract to assist operators in locating water concerns and applying protection methods. This is accomplished during contract preparation and implemented during layout of the sale.*

- All protected stream courses will be illustrated on the Sale Area Map.

- Water drafting will be from existing drafting sites and will be identified on the Sale Area Map.

- Units that use tractor yarding will be designated on the Sale Area Map.

BMP 1.5 – Limiting Operating Period of Timber Sale*: To prevent soil compaction and erosion from operations during wet weather; and to ensure placement of erosion control structures prior to the onset of winter to reduce water quality impacts. This is accomplished during the timber sale operations.*

- The Project is proposed to take place during the normal operating season (NOS) that is defined as April 15 to October 15 and in dry periods outside the NOS with Line Officer approval. Activities will be restricted during periods of wet weather during the NOS.

- When stormy weather is predicted, the TSA will be on site to insure that winterization or erosion control procedures are implemented in a timely fashion and to initiate shutdown or resume operations. Operations will not resume until suitable weather, soil, and forecast conditions exist.

- Forecast periods will be of a suitable length to allow completion or winterization of the task undertaken before precipitation events occur.

- The Wet Weather Operating Standards (WWOS) (USFS 2002a) will be used to guide operations, especially haul, during periods of wet weather. The TSA will examine field conditions to determine when the soil and/or road have dried out enough to enable operations to resume without risk of watershed impacts. The project earth scientist may be called on to make recommendations to the TSA who will provide direction to the Contractor as to when operations may resume to insure that BMPs will be met and adverse impacts will be avoided.

BMP 1.6 – Protection of Unstable Lands: Provides for special treatment of unstable areas to avoid triggering mass slope failure with resultant erosion and sedimentation.

- Project watershed personnel conducted field reviews of all proposed harvest units, identified unstable areas observed in the field, reviewed the marking prescription, and documented findings in project reports.

- Unstable lands will be identified on the Unit Information Cards, and equipment will be excluded from them.

- Project watershed personnel will be available for consultation during project implementation when activities occur in or adjacent to unstable areas.

BMP 1.8 – Streamside Management Zone (SMZ) Designation*: Designates zones adjacent to water and/or riparian areas as zones of special management. This is accomplished during the planning and layout phase of the project.*

- Riparian Reserves within the project area have been designated; the IDT identified one site-potential tree height as 170 feet.

- Existing landings within 50 feet of the slope break to a stream channel or inner gorge will not be used.

- Sites for water drafting for dust abatement will be designated by the Forest Service and agreed to by the purchaser. Water drafting will meet the NOAA 2001 design standards when drafting from anadromous fish bearing stream reaches.

- There will be no yarding of trees or logs, through, in, or across stream channels.

- For all units where thinning is prescribed in RRs associated with intermittent stream channels, equipment will not operate within 50 feet of the break in slope to the wetted channel or inner gorge of intermittent streams. Where a clear break in slope is not evident, equipment will not operate within 50 feet of the wetted channel of any intermittent stream.

BMP 1.9 – Determining Tractor Loggable Ground*: Minimize erosion and sedimentation resulting from ground disturbance of tractor logging systems.*

- The Soil Scientist field reviewed the tractor log units to verify that they were reasonable to tractor log from a soil resource perspective based upon the combination of percent slope distribution, soil properties and erosion hazard rating.

- Project design features, such as restricting skidding equipment to slopes generally <35 percent and using endlining on slopes >35 percent will minimize disturbance to the steeper slopes in tractor units.

BMP 1.10 – Tractor Skidding Design*: Designates a tractor skid pattern to avoid oversteepened areas, designates tractor crossings, and reduces skid patterns in sensitive areas to reduce erosion and compaction. This is accomplished during the sale layout and operations phase of the project.*

- Existing skid trails will be reused whenever possible.

- Skidding occurs generally on slopes less than 35 percent.

- If sections of skid trails have slopes exceeding 35 percent, slash or certified straw will be placed on them as determined necessary by the TSA.

- The location of operating slopes for ground based harvest systems will have a Forest Service representative design and approve areas for logging equipment to work and an earth scientist will provide recommendations if needed.

- Skid trails that intersect Forest Roads will be obliterated at the intersection.

- The location of new skid trails within RRs associated intermittent streams will be by agreement between the Timber Sale Contractor and the TSA. Perennial streams will not be

crossed by skid trails. Intermittent channels may be crossed when dry and at locations designated by the Forest Service.

- Limit equipment disturbance within 20 feet on either side of swales, minimize equipment crossings, and avoid running trails up the axis of swales.

BMP 1.11 – Suspended Log Yarding in Timber Harvesting*: Protect the soil mantle from excessive disturbance, maintain the integrity of the SMZ and other sensitive watershed areas, and to control erosion on cable corridors.*

- All skyline yarding units will require one end suspension. Full suspension will be required for any yarding across or over streams.

- Ground-based skidding will require front-end suspension of logs on skid trails.

BMP 1.12 – Log Landing Location*: Locate new landings or reuse existing landings in such a way as to avoid watershed impacts and associated water quality degradation.*

- Existing landings will be used to the extent possible.

- New and old landings would be selected for use that involves the least amount of excavation, and the least erosion potential.

- Do not use existing landings within 50 feet of the slope break to a stream channel or inner gorge.

BMP 1.13 – Erosion Prevention and Control Measures During Timber Sale Operations*: Ensures that Purchasers operations shall be conducted reasonably to minimize soil erosion. This is accomplished during the pre-operations meeting with the purchaser, and throughout the operations phase of the timber sale.*

- Erosion control measures are discussed during the pre-operations meeting with the purchaser and the Forest Service. They are updated throughout the operations phase of the timber sale.

- During project implementation, final locations and design characteristics for landings and new roads will be reviewed by watershed personnel prior to construction as needed.

- The project earth scientist will make periodic inspections of the sale to insure that the erosion control measures are having the desired effect and are in compliance with BMPs. The earth scientist will make recommendations to the FSR as to any action needed to comply with BMPs.

- The Klamath Wet Weather Operation Standards (WWOS) (USFS 2002a) will be used.

- Storms may temporarily suspend operations to insure BMP compliance and to avoid adverse impacts to T & E species or species of concern (Region 5 sensitive).

- When stormy weather is predicted, the TSA will be on site to insure that winterization procedures are implemented in a timely fashion and to initiate shutdown or resume operations. Operations will not resume until suitable weather, soil, and forecast conditions exist.

- Also see BMP 1.5 and 1.11.

BMP 1.16 – Log Landing Erosion Prevention and Control*: Works to reduce erosion and subsequent impacts sedimentation from log landings. Timber Sale Contract provide for erosion prevention and control measures on all landings. This is best done by design of landing drainage measures during the planning phase of the project, and implemented during the operations phase.*

- Proposed landings were identified on the Project planning map and were evaluated by earth scientists.

- Landings are shaped to disperse drainage and direct runoff away from watercourses at the time of construction. Rock armoring and silt fences with straw bales may be used as necessary to direct water to areas of suitable drainage and to capture sediment. All new landing cut and fill slopes will be mulched and the mulch will be maintained throughout the life of the project.

- The Project will utilize existing landings whenever possible. Swing Boom Yarding (SBY) will be required within the timber sale contract to minimize the need to construct new landings.

- New landings to be constructed will not be located within RRs and will be kept as small as feasible, while meeting safe working standards.

BMP 1.17 – Erosion Control on Skid Trails*: Employs preventive measures such as drainage structures to reduce water concentration and erosion. This is accomplished during the operations phase of the project.*

- Each skid trail will be water-barred before the sale is completed.

- Skid trails that intersect Forest Roads will be obliterated at the intersection.

- Skid trails that cross dry swales (i.e., depressions in the landscape that do not meet definition for a designation as an RR) will be restored before any storm (with reasonable chance of causing offsite sediment movement), or after use is complete. This generally consists of removing excess soil, reshaping and waterbarring former approaches, and spreading slash on the former crossing.

- Tractor skidding will be done when soil moisture conditions are dry within 4 inches of the surface on existing skid trails and dry to 10 inches of the ground surface off skid trails.

BMP 1.19 – Streamcourse Protection*: Protects the natural flow of streams and reduces the entry of sediment and any other pollutants into streams. The location of stream crossings must be agreed to by the Sale Administrator and the Hydrologist. The accomplishment of the objective of this measure is during the operations phase of the project.*

- Landings are located away from channels. Fuel containment systems will be used at all landings.

- Skid trails will be a minimum of 50 feet from the break in slope to the wetted stream channels or the inner gorge.

- Straw bales, rock, and containment dikes will be used as needed at water drafting sites and service landings to capture any spilled water and prevent runoff to streams.

- There will be no yarding of trees or logs below the break in slope or in inner gorge areas.

BMP 1.20 – Erosion Control Structure Maintenance*: Requires periodic inspection of erosion control structures to assess maintenance needs and effectiveness. This is accomplished during the operations and post-operations phase of the project; this ensures the adequacy of erosion control measures.*

- When stormy weather is predicted, the TSA will be on site to insure that winterization procedures are implemented in a timely fashion and to initiate shutdown or resume operations. Operations will not resume until suitable weather, soil, and forecast conditions exist.

- The TSA will examine field conditions to determine when the soil and/or road have dried out enough to enable operations to resume without risk of watershed impacts. The project earth scientist may be called on to make recommendations to the TSA who will provide direction to the Contractor as to when operations may resume to insure that BMPs will be met and adverse impacts will be avoided.

- Temporary roads will be graded to outslope.

- A barrier to prevent vehicle traffic and use will be placed at all temporary road takeoffs at the end of the operating season.

- Temporary roads will be water-barred after use and then will be decommissioned at the end of the project. Klamath WWOS will be followed. Spot rocking will used as necessary if small and isolated portions of the road system do not adequately dry to allow haul when most of the road is capable of haul, provided haul over the newly rocked areas will not create adverse impacts, such as sediment moving off site towards channels.

BMP 1.21 – Acceptance of Erosion Control Measures Before Timber Sale Closure*: Erosion control measures are inspected for adequacy to ensure erosion control as planned. This is accomplished during the post-operations phase of the project during the contract final inspection.*

- Landings will be shaped for drainage.

- Landings that will not be used again will be contour ripped and covered with slash or weed free straw if necessary.

- At project completion, permanent operating water bars will be installed and-or repaired as necessary on all skid trails, and slash scattered on all skid trails if necessary available.

- Temporary roads will be graded to outslope and covered with slash if needed at termination of activities during the season of use.

- A barrier will be placed at the takeoff of the temporary roads.

BMP 1.25 – Modification of the Timber Sale Contract (as needed)*: Allows Contract language to be modified to add or increase protection of water quality not identified in the planning process.*

- Modifications are not expected at this time but this BMP is retained to illustrate that contract alteration will occur if needed to insure maintenance of water quality, especially if unforeseen circumstances and impacts occur.

BMP 2.1 – General Guidelines of the Location and Design of Roads*: To locate and design roads with minimal resource damage.*

- Road construction will be designed:
  - *For minimal cut and fill*
  - *On or near ridges*
  - *On gently sloping ground*
  - *Outside RRs*

- Temporary roads were identified on the Project planning map and were evaluated by earth scientists.

BMP 2.2 – Erosion Control Plan*: The objective is to limit and control sedimentation through effective planning prior to the initiation of construction activities and through effective contract administration. This is accomplished during the pre-operations and operations phase of the project.*

- Resource protection measures are incorporated into the proposed action by the IDT and these actions are then incorporated into the contract specifications and provisions. Examples are most of the actions described above and include such items as: shaping landings, temporary roads and skid roads for drainage and use of rock as necessary to obtain suitable haul bases on FS roads.

- When stormy weather is predicted, the TSA will be in contact with the sale administrator to insure winterization procedures are implemented in a timely fashion and to initiate shutdown or resume operations. Operations will not resume until suitable weather, soil, and forecast conditions exist.

- The WWOS will be used to guide operations, especially haul, during periods of wet weather. The TSA will examine field conditions to determine when the soil and/or road have dried out enough to enable operations to resume without risk of watershed impacts. The project earth scientist may be called on to make recommendations to the TSA who will provide direction to the Contractor as to when operations may resume to insure that BMPs will be met and adverse impacts will be avoided.

BMP 2.3 – Timing of Construction Activities*: The objective is to minimize erosion by conducting operations during minimal runoff periods. This is accomplished during the operations phase of the project by the contract administrator and the project earth scientist.*

- All landing, temporary road and skid road construction, and all existing temporary road skid road reconstruction, will be conducted during appropriate periods of weather and soil moisture to insure BMP attainment and the avoidance of adverse impacts to listed species. Forecast periods will also be of a suitable length to allow completion or winterization of the task undertaken before precipitation events occur.

- When stormy weather is predicted, TSA will be on site to insure that winterization procedures are implemented in a timely fashion and to initiate shutdown or resume operations. Operations will not resume until suitable weather, soil, and forecast conditions exist.

- The WWOS will be used to guide operations, especially haul, during periods of wet weather. The TSA will examine field conditions to determine when the soil and/or road have dried out enough to enable operations to resume without risk of watershed impacts. The project earth scientist may be called on to make recommendations to the TSA who will provide direction to the Timber Sale Contractor as to when operations may resume to insure that BMPs will be met and adverse impacts will be avoided.

BMP 2.4 – Road Slope Stabilization (Preventive Practices)*: The objective is to improve road slope stabilization by applying mechanical and vegetative measures. This is accomplished during the operations phase of the Project.*

- All landings, temporary road, and skid trail construction, and road re-conditioning will be conducted during appropriate periods of weather and soil moisture to ensure BMP attainment and the avoidance of adverse effects to listed species. Favorable forecast periods will also be of a suitable length to allow completion or winterization of the task undertaken before precipitation events occur.

- Landings will be shaped for drainage at the time of construction. Rock armoring and silt fences with straw bales will be used as necessary to direct water to suitable areas of drainage and to capture sediment. All landing cut and fill slopes will be straw mulched and the mulch is maintained throughout the life of the Project.

- The WWOS will be followed. Rocking will be used as necessary.

- Temporary roads will be closed and storm-proofed when not in use (steeper segments will be mulched as needed). Temporary roads will be decommissioned within one year following completion of timber sale activities.

BMP 2.5 – Road Slope Stabilization (Administrative Practices)*: The objective is to reduce sedimentation by minimizing erosion from road slopes and by minimizing the chances of slope failures along roads. This is accomplished by road design measures during the planning phase of the project.*

- When stormy weather is predicted, the TSA will be on site to insure that winterization procedures are implemented in a timely fashion and to initiate shutdown or resume operations. Operations will not resume until suitable weather, soil and forecast conditions exist.

- The WWOS will be used to guide operations, especially haul, during periods of wet weather. The TSA will examine field conditions to determine when the soil and/or road have dried out enough to enable operations to resume without risk of watershed impacts. The project earth scientist may be called on to make recommendations to the TSA who will provide direction to the Contractor as to when operations may resume to insure that BMPs will be met and adverse impacts will be avoided.

- Any proposed road alignment that crosses slopes with visible indicators of instability (ground fracture, settling, seeps, jack-strawed trees), will be field reviewed by an earth scientist.

- Any proposed road alignment that crosses or encroaches on a mapped landslide feature will be reviewed by an earth scientist.

BMP 2.11 – Minimization of Sidecast Material*: The objective is to minimize sediment production originating from material sidecast during road construction or maintenance. This is accomplished during the design phase of the project by the contract inspector.*

- Minor blading will occur on temporary roads used by the project. Side-casting of soil during blading operations will be minimal due to the low gradient slopes on which the temporary roads are located.

- During reconstruction of any landings, material will not be sidecast where it can enter a stream channel.

BMP 2.12 – Servicing and Refueling of Equipment*: The objective is to prevent pollutants such as fuels, lubricants, bitumens, raw sewage, wash water, and other harmful materials from being discharged into or near rivers, streams, impoundments, or natural and man-made channels which lead into them. This is accomplished through the use of designed and designate refueling areas.*

- Fuel containment systems will be in place on landings as necessary.

- Refueling and maintenance of Project motorized equipment will occur at least 200 feet away from any channel.

BMP 2.16 – Stream Crossings on Temporary Roads*: The objective is to ensure that temporary roads do not unduly damage stream channels and to insure that fish passage is unimpeded by stream crossing structures.*

- The number of crossings is kept to a minimum needed for access.

- Temporary crossings will be removed and the site stabilized prior to any storm (i.e., when there is significant potential for offsite sediment movement) or when the facility is no longer needed, whichever is earliest.

BMP 2.21 – Water Source Development Consistent with Water Quality Protection*: The objective is to limit and mitigate the effects of water source development through the planning of impoundments and withdrawals.*

- Drafting sites are existing sites and rocking of approaches will be used as required. All boards and plastic will be removed after use. Straw bales, rock surfacing and containment dikes will be used at all locations where the possibility of water spill or overflow will result in sediment being moved toward the creek.

- Drafting sites and methods will follow NOAA-Fisheries 2001 direction including screen size and the amount of flow withdrawal guidelines when drafting from anadromous fish bearing stream reaches.

- Water trucks will be required to remain on existing, rocked roads.

BMP 2.22 – Maintenance of Roads*: The objective is to limit sedimentation and erosion by road drainage maintenance and road surface protection. This is accomplished during the operations phase of the project and the post-operations final inspection.*

- The Klamath WWOS will be followed. Spot rocking will used as necessary if small and isolated portions of the road system do not adequately dry to allow haul when most of the road is capable of haul, provided haul over the newly rocked areas will not create adverse impacts, such as sediment moving offsite towards channels.

- When stormy weather is predicted, the TSA will be on site to insure that winterization procedures are implemented in a timely fashion and to initiate shutdown or resume operations. Operations will not resume until suitable weather, soil, and forecast conditions exist.

- The WWOS will be used to guide operations, especially haul, during periods of wet weather. The TSA will examine field conditions to determine when the soil and/or road have dried out enough to enable operations to resume without risk of watershed impacts. The project earth scientist may be called on to make recommendations to the TSA who will provide direction to the Contractor as to when operations may resume to insure that BMPs will be met and adverse impacts will be avoided.

- Appropriate road watering will occur as roads dry to maintain road fines on site.

BMP 2.23 – Road Surface Treatment to Prevent Loss of Materials*: The objective is to reduce road related erosion through treatment of the road surface, usually through spot rocking and dust abatement. This is accomplished during the operations phase of the project.*

- The Klamath WWOS will be used for all Project activities (harvest, hauling, planting). The public uses many roads within the analysis area throughout the year and control of this use is outside the scope of the Project or the Klamath National Forest's jurisdiction.

- Spot rocking will used as necessary if small and isolated portions of the road system do not adequately dry to allow haul when most of the road is capable of haul, provided haul over the newly rocked areas will not create adverse impacts, such as sediment moving offsite towards channels.

- Landings will be outsloped and rocked if necessary to improve drainage away from existing channels.

- The WWOS dictate conditions that control ground-disturbing operations. For example, if more than 10 percent of a road segment is rutted 2 inches in depth, road use will be suspended.

- TSAs will be on site daily when new locations and conditions are encountered and to insure that appropriate winterization procedures are implemented in a timely fashion and to initiate shutdown or resume operations. Operations will not resume until suitable weather, soil and forecast conditions exist.

- A Dust Abatement Plan is required under the Timber Sale Contract, Specification CT5.4, under road maintenance. Roads to be dust abated with water will be specified in the contract by project engineer.

- Appropriate road watering on other project roads will occur as roads dry to maintain road fines on site.

BMP 2.24 – Traffic Control During Wet Periods*: The objective is to reduce damage to road drainage and limit sedimentation from roads during wet periods. This is generally achieved by increased surfacing and/or road closures during the operations phase of the project.*

- The Klamath WWOS will be used for all project activities (hauling, fuel treatment, road opening and decommissioning), but the public uses many roads within the project area throughout the year.

- The WWOS dictate conditions that control ground-disturbing operations. For example, if more than 10 percent of a road segment is rutted 2 inches in depth road use will be suspended.

BMP 2.26 – Obliteration or Decommissioning of Roads*: The objective is to reduce sediment generated from temporary roads, unneeded system (classified) and non-system (unclassified) roads by obliterating or decommissioning them at the completion of the intended use. This BMP applies to all temporary roads.*

- Roads are to be drained by measures such as re-contouring or outsloping to return the road prism to near natural hydrologic function.

- Road prisms requiring more sediment reduction would be stabilized through appropriate treatment such as tillage, ripping, fertilization, and/or revegetation.

- Road take-offs would be obliterated or effectively blocked to vehicle access.

BMP 5.2 – Slope Limitations for Mechanized Equipment Operations*: The objective is to reduce gully and sheet erosion and associated sediment production by limiting tractor use.*

- Skidding equipment (track or rubber tired) would be generally restricted to slopes <35 percent.

- Masticating equipment may operate on slopes up to 45 percent.

BMP 5.4 – Revegetation of Surface Disturbed Areas*: The objective is to protect water quality by minimizing soil erosion through the stabilizing influence of vegetation. This is accomplished during the operations and post-operations phase of the project. Temporary roads that are decommissioned will be mulched and seeded in areas that have high erosion potential.*

- Steep (>35 percent) portions of skid trails will be covered with slash as needed.

BMP 5.5 – Disposal of Organic Debris*: The objective is to prevent gully and surface erosion with associated reduction if sediment production and turbidity during and after treatment.*

- Hand pile and pile burning, underburning and mastication would be used to reduce the fine fuel component. Specified soil cover recommendations would be used to maintain sufficient soil cover for erosion prevention.

Appendix C

Site-specific Best Management Practices

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Site-specific Best Management Practices

Treatment Unit	Stand	BMP Implementation Notes
M Unit 3	751	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 4	752	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 5	753	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 6	754	BMP 1.6 Recent landslide at old landing site just below unit's north boundary. Unit occurs along Grouse Point Fault (contact between schist and serpentine). No active slides in unit but potential exists. TSA to consult earth scientist if active instability is encountered during layout. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 7N	773	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 7S	755	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 8	756	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 9	502	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 10	757	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 11	758	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 12	509	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 13	303	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 15	701	BMP 1.11 Layout cable corridors to maximize log suspension and minimize surface disturbance to small areas of wet soil scattered through unit. BMP 1.14 Scatter slash to 70% ground cover on any wet areas disturbed by yarding. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 16	702	BMP 1.8 Hold unit boundary on northeast back from intermittent channel 170 feet. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 17	703	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35% BMP 2.6 Correct road drainage problems at bottom of unit along 39N20
M Unit 18	704	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 19	705	BMP 1.8 RR designated in lower portion of center-most draw. Hold unit boundary above 4240 contour to avoid incursion into RR. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 20	706	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 21	707	BMP 1.8 Establish 50 foot equipment exclusion SMZ along draw in southwest corner of unit below 39N73. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 22	801	BMP 1.8 Establish 50 foot SMZ along draw in north half of unit below 4000-foot contour. Maintain 70% ground cover in SMZ. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%

Treatment Unit	Stand	BMP Implementation Notes
M Unit 23	802	BMP 1.6 Small soil slips (very small and shallow) observed in unit. Slopes up to 80%. Thin conservatively to retain necessary rooting mass to reinforce soil. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 24	803	BMP 1.8 Hold unit boundary back from RR on south boundary or establish 170 foot SMZ – equipment exclusion, 70% ground cover retention, 60% canopy retention. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 25	804	BMP 1.11 Layout cable corridors to maximize log suspension and minimize surface disturbance to small areas of wet soil scattered through unit. BMP 1.14 Scatter slash to 70% ground cover on any wet areas disturbed by yarding. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 30	553	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 31	351	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 32	552	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 35	805	BMP 1.11 Layout cable corridors to maximize log suspension and minimize surface disturbance to small areas of wet soil scattered through unit. BMP 1.14 Scatter slash to 70% ground cover on any wet areas disturbed by yarding. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 36	806	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 37	708	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 38	709	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 39	759	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 40	761	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 43	762	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 51	554	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 52	710	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 54	712	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 55	763	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 60	807	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 61	808	BMP 1.6 Unit located just below old earthflow. TSA to consult earth scientist if active instability is encountered during layout. BMP 1.8 Spring fed draws border unit. Establish 50-foot equipment exclusion zone measured from edge of saturated soil. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 62	803	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 63	810	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 64	714	BMP 1.8 Hold unit boundary on south back from intermittent channel (RR) 170 feet.
M Unit 65	764	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%

Treatment Unit	Stand	BMP Implementation Notes
M Unit 66	765	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 69	768	BMP 1.8 Intermittent channel borders unit on the north end. 50 foot equipment exclusion zone. Maintain minimum 70% ground cover. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 73	306	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 75	505	BMP 1.11 Full log suspension 50 feet each side of centerline of intermittent draws running through unit. BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 76	506	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 79	307	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
M Unit 80	772	BMP 1.9 Refine limits of tractor ground during unit layout. BMP 1.10 Mulch or slash any skid trails on slopes over 35%
RS 1	300	Implement BMPs to normal standards.
RS 2	300	BMP 1.9 Limit masticator to slopes less than 45%
RS 3	300	BMP 1.8 Maintain 70% ground cover and 70% shade canopy in RRs (170 foot width). 50-foot exclusion zone for masticator. BMP 1.9 Limit mastication to slopes less than 45%
FRZ 2		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 3		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 4		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 5		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 6		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 7		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 9		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 10		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 11		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 12		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 13		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 14		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.

Treatment Unit	Stand	BMP Implementation Notes
FRZ 15		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 16		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 17		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
FRZ 20		BMP 1.9 Limit masticator to slopes less than 45%. BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
Rx Unit 1		BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
Rx Unit 2		BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
Rx Unit 3		BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
Rx Unit 4		BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
Rx Unit 5		BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
Rx Unit 6		BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
Rx Unit 7		BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
Rx Unit 8		BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
Rx Unit 9		BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
Rx Unit 11		BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.
Rx Unit 12		BMP 6.2 Develop burn prescriptions to retain 70% ground cover and 70% shade canopy in RRs. BMP 6.3 Waterbar and scatter slash on any fire lines constructed in RRs.

Appendix D
Cumulative Watershed Effects Analysis

Table D-1. Comparison of results from the 2014 and 2021 CWE model runs to the current watersheds conditions in 2008 for Alternative B.

	USLE			ERA			GEO		
	Current	2014	2021	Current	2014	2021	Current	2014	2021
7th-field Watersheds									
Black Bear Creek	0.39	0.50	0.39	0.32	0.32	0.18	0.44	0.42	0.39
Cody-Jennings Creek	0.41	0.41	0.41	0.24	0.20	0.16	0.49	0.47	0.43
Crawford Creek	0.46	0.47	0.46	0.22	0.29	0.20	0.29	0.28	0.27
Eddy Gulch	1.05	1.06	1.05	0.39	0.41	0.39	0.79	0.78	0.78
Gooey-Ketchum Creek	0.26	0.26	0.26	0.12	0.12	0.11	0.50	0.50	0.50
Gould-East Fork South Fork Salmon River	0.35	0.35	0.40	0.16	0.17	0.21	0.45	0.45	0.45
Indian Creek	0.53	0.53	0.53	1.04	0.59	0.24	0.87	0.78	0.66
Kanaka-Olsen Creek	0.19	0.19	0.19	0.30	0.19	0.12	1.53	1.28	0.99
Lower North Russian Creek	0.24	0.25	0.24	0.17	0.18	0.17	0.47	0.47	0.47
Lower South Russian Creek	0.40	0.41	0.40	0.54	0.52	0.43	0.55	0.54	0.53
Matthews Creek	0.42	0.43	0.42	0.15	0.16	0.15	0.47	0.46	0.46
Robinson-Rattlesnake Creek	0.24	0.24	0.24	0.17	0.15	0.14	0.34	0.33	0.33
Shadow Creek	0.94	0.96	0.97	0.18	0.29	0.25	0.41	0.41	0.41
Sixmile Creek	0.52	0.52	0.52	0.12	0.12	0.13	0.36	0.36	0.36
Tanner-Jessups Creek	0.47	0.47	0.47	0.51	0.43	0.38	0.61	0.59	0.58
Taylor Creek	0.26	0.26	0.26	0.16	0.16	0.15	0.20	0.20	0.20
Timber-French Creek	0.24	0.24	0.24	0.14	0.12	0.10	0.31	0.31	0.30
Upper North Russian Creek	0.35	0.37	0.35	0.32	0.43	0.29	0.87	0.86	0.86
Whites Gulch	0.53	0.54	0.53	0.21	0.22	0.20	0.35	0.34	0.33
6th-field Watersheds									
Cecilville-Crawford Creek	0.37	0.35	0.34	0.20	0.20	0.15	0.36	0.35	0.33
Main East Fork South Fork Salmon River	0.38	0.38	0.39	0.13	0.16	0.15	0.29	0.29	0.29
North Russian Creek	0.28	0.29	0.28	0.21	0.24	0.19	0.46	0.46	0.45
Plummer-Black Bear Creek	0.23	0.26	0.24	0.25	0.21	0.13	0.41	0.38	0.35
South Russian Creek	0.21	0.21	0.21	0.20	0.18	0.14	0.27	0.26	0.25
Whites-Jackass Creek	0.55	0.55	0.55	0.26	0.25	0.23	0.49	0.48	0.47
5th-field Watersheds									
North Fork Salmon	0.19	0.18	0.18	0.23	0.18	0.14	0.55	0.49	0.42
South Fork Salmon	0.29	0.28	0.28	0.26	0.23	0.17	0.38	0.36	0.33

Table D-2 lists results of CWE analysis for watersheds in the LSR under Alternative B with the North Fork Roads Stormproofing Project.

Alternative C was modeled separately but produced identical risk ratios because of the very small differences between the alternatives. The risk ratios reported for 2009 represent existing conditions plus foreseeable future actions (North Fork Roads Stormproofing Project). The values reported for 2014 represent conditions at a point in time when all mechanical treatments will be complete. The values reported for 2021 represent the point in time when all treatments have been implemented.

Table D-2. CWE model results for Alternative B combined with the future project–North Fork Roads Stormproofing Project.

	USLE				ERA				GEO			
	Current (2008)	Current Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021	Current (2008)	Current/ Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021	Current (2008)	Current Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021
7th-field Watersheds												
Black Bear Creek	0.39	0.39	0.50	0.39	0.32	0.32	0.32	0.18	0.44	0.44	0.42	0.39
Cody-Jennings Creek	0.41	0.41	0.41	0.41	0.24	0.24	0.20	0.16	0.49	0.49	0.47	0.43
Crawford Creek	0.46	0.46	0.47	0.46	0.22	0.22	0.29	0.20	0.29	0.29	0.28	0.27
Eddy Gulch	1.05	0.90	0.91	0.90	0.39	0.32	0.35	0.33	0.79	0.62	0.61	0.60
Gooey-Ketchum Creek	0.26	0.26	0.26	0.26	0.12	0.12	0.12	0.11	0.50	0.50	0.50	0.50
Gould-East Fork South Fork Salmon River	0.35	0.35	0.35	0.40	0.16	0.16	0.17	0.21	0.45	0.45	0.45	0.45
Indian Creek	0.53	0.53	0.53	0.53	1.04	1.04	0.59	0.24	0.87	0.87	0.78	0.66
Kanaka-Olsen Creek	0.19	0.15	0.15	0.15	0.30	0.27	0.17	0.10	1.53	1.43	1.18	0.90
Lower North Russian Creek	0.24	0.21	0.22	0.21	0.17	0.15	0.16	0.15	0.47	0.41	0.41	0.41
Lower South Russian Creek	0.40	0.30	0.31	0.30	0.54	0.42	0.40	0.31	0.55	0.36	0.35	0.34
Matthews Creek	0.42	0.42	0.43	0.42	0.15	0.15	0.16	0.15	0.47	0.47	0.46	0.46
Robinson-Rattlesnake Creek	0.24	0.21	0.21	0.21	0.17	0.16	0.13	0.13	0.34	0.32	0.31	0.31
Shadow Creek	0.94	0.93	0.96	0.97	0.18	0.18	0.29	0.25	0.41	0.41	0.41	0.41
Sixmile Creek	0.52	0.52	0.52	0.52	0.12	0.12	0.12	0.13	0.36	0.36	0.36	0.36
Tanner-Jessups Creek	0.47	0.34	0.34	0.34	0.51	0.46	0.37	0.32	0.61	0.41	0.39	0.38
Taylor Creek	0.26	0.23	0.23	0.23	0.16	0.14	0.14	0.13	0.20	0.15	0.15	0.15
Timber-French Creek	0.24	0.24	0.24	0.24	0.14	0.14	0.12	0.10	0.31	0.31	0.31	0.30
Upper North Russian Creek	0.35	0.27	0.30	0.27	0.32	0.26	0.37	0.23	0.87	0.60	0.59	0.58
Whites Gulch	0.53	0.28	0.29	0.28	0.21	0.13	0.14	0.12	0.35	0.19	0.17	0.17

Table D-2. CWE model results for Alternative B combined with the future project–North Fork Roads Stormproofing Project (continued).

	USLE				ERA				GEO			
	Current (2008)	Current Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021	Current (2008)	Current/ Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021	Current (2008)	Current Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021
6th-field Watersheds												
Cecilville-Crawford Creek	0.37	0.37	0.35	0.34	0.20	0.20	0.20	0.15	0.36	0.36	0.35	0.33
Main East Fork South Fork Salmon River–	0.38	0.38	0.38	0.39	0.13	0.13	0.16	0.15	0.29	0.29	0.29	0.29
North Russian Creek	0.28	0.24	0.25	0.24	0.21	0.18	0.21	0.16	0.46	0.35	0.35	0.34
Plummer-Black Bear Creek	0.23	0.23	0.26	0.24	0.25	0.25	0.21	0.13	0.41	0.41	0.38	0.35
South Russian Creek	0.21	0.15	0.16	0.15	0.20	0.16	0.14	0.10	0.27	0.16	0.15	0.14
Whites-Jackass	0.55	0.39	0.39	0.39	0.26	0.21	0.19	0.18	0.49	0.35	0.34	0.33
5th-field Watersheds												
North Fork Salmon River	0.19	0.15	0.13	0.13	0.23	0.20	0.16	0.11	0.55	0.48	0.41	0.34
South Fork Salmon River	0.29	0.29	0.28	0.28	0.26	0.26	0.23	0.17	0.38	0.38	0.36	0.33

Of all the 7th-field watersheds in the analysis, only Kanaka-Olsen has risk ratios over 1.0, and that represents the current condition (GEO=1.43) as of 2008. By 2014 the risk ratios are declining due to vegetative recovery. Increases in risk ratios due to project activities are very small. As an example, Shadow Creek, which contains the largest area in mechanical treatments, increases from USLE=0.93 to 0.97 by project conclusion in 2021. All other watersheds have risk ratios that hold static or decline over the period of project implementation.

Under existing conditions, none of the 5th- or 6th-field watersheds are over threshold for surface soil erosion, mass-wasting, or equivalent roaded area, and project activities would not change that situation.

The modeled foreseeable future action (North Fork Roads Stormproofing Project) brought the Eddy Gulch 7th-field USLE risk ratio below threshold (USLE = 1.05 to 0.90) and lowered the Kanaka-Olsen 7th-field GEO risk ratio (GEO = 1.53 to 1.43).

Project activities would not result in any watershed going over threshold nor would they create any major increases in risk ratios. At project conclusion, most risk ratios are at levels equal to or less than those that currently exist. The action alternatives are expected to result in reduced risk ratios over the long term by reducing the risk of stand-replacing wildfire. There are no expected long-term cumulative effects on water quality or aquatic habitat or populations. It is expected that habitat quality will be improved in the long term as a result of project implementation.

Proposed thinning would occur across the landscape in FRZs and roadside treatment areas, including within Riparian Reserves, but would have insignificant short- and long-term adverse effects on fish and aquatic habitat due to the proposed methods (hand work and mastication), which will result in minimal soil disturbance or reduction in soil productivity.

No more than 10 percent of any 6th-field watershed would receive fuel hazard reduction treatments in any given year. Sediment and associated negative effects generated from fuel hazard reduction actions are expected to be insignificant in the short and long term because the activities are dispersed throughout the landscape, of low intensity, and will have resource protection measures and BMPs implemented that will minimize effects on soils and vegetation.

Riparian Reserve sediment filtration capacity will be maintained and existing habitat conditions (water quality and riparian function) will be maintained. The action alternatives would not add cumulatively to existing, ongoing, or future impacts.